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The Asian Weaver Birds: Problems of co-existence and evolution with particular reference to Behaviour

BY

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Sub-Department of Animal Behaviour, Zoological Laboratory, Cambridge

(*With two plates, five text-figures, and three diagrammatic schemes*)

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I. INTRODUCTION

a. Aim

In many parts of tropical Asia two or more weaver species (Ploceinae), often apparently very closely related indeed, may be found side by side in a common, usually fairly homogeneous, environment. The question is at once posed as to how reproductive isolation is maintained between them and whether they compete with one another for certain biological necessities [1]. In recent years the ecology and behaviour of the commonest species, the Baya *Ploceus philippinus*, has been much studied (Ali 1931, Ali & Ambedkar 1956, 1957, Ambedkar 1958 and in preparation, Crook 1960c), and in 1959 a start was made on the other Indian species about which, apart from notes in Jerdon (1877), Oates (1883), Hume (1890), and Stuart Baker (1926, 1934), the standard works on Indian ornithology, and a short study by Spennemann (1926), very little was known. The area chosen for a comparative field study was the Kumaon tarai for this was known to be one of the localities where extensive sympatry of at least three species occurred.

During the visit the elusive Finn's Baya (*Ploceus megarhynchus* Hume), for long one of the mysteries of Indian ornithology, was rediscovered (Ali & Crook 1959) so that a total of four species was kept under observation throughout the same period. The enquiry was of necessity exploratory and consisted mainly in recording hitherto unknown details of the ecology and reproductive behaviour of *Ploceus manyar*, *P. benghalensis*, and *P. megarhynchus*, details which were quantified whenever possible. The observations on *P. megarhynchus* have already been published (Ali & Crook 1959) and the aim of this paper is, firstly to present the new data on *P. manyar* and *P. benghalensis* and, after comparisons with other Asian weavers, to review briefly the problems presented by the extensive sympatry of the group. As the paper goes to press the ecological work is being continued in Kumaon by Dr. Sálim Ali and Shri Vijaykumar Ambedkar.

b. Study area—the Kumaon tarai

Below the Himalayan foothills the Kumaon area consists of a northern tract of forested country known as 'bhabar' and, to the south of this, a flat largely treeless and often flooded stretch of grassland known as the 'tarai'. This type of country extends parallel to the bhabar for most of the length of the Himalayas north of the Ganges plain and reaches southwards to the river. The contrast between the forested bhabar and the swampy tarai depends on the fact that the drainage water from the Himalayas runs very deeply below the surface in bhabar, necessitating the construction of concrete surface runs from the hills and deep wells, whereas it emerges on the surface of the plain in the tarai and moves slowly along meandering streams and rivers down to the Ganges. In the monsoon season the tarai is subject to extensive flooding.

---

[1] Modern theory assumes that species originate in the following way. The appearance of geographical barriers between local populations of a species prevents gene exchange between them. In isolation the adaptive differentiation of the separated populations continues leading to regional contrasts in physical, physiological, and behavioural characters which may prevent inter-breeding if and when an overlap in distribution occurs. If reproductive isolation is complete when this occurs the sibling populations are considered distinct species (Dobzhansky 1941, Huxley 1942, Mayr 1942, Lack 1944). The contrasts of particular importance in preventing interbreeding are differences in courtship and mating behaviour and in habitat and food preferences (Hinde 1959). Furthermore the co-existence of sibling or closely related species in the same general environment depends also on the absence of ecological competition between them (Gause 1934, Crombie 1947).

The four weaver species occur almost exclusively in the tarai, only the Common Baya having colonies in the agricultural lands in cleared bhabar. In the Rudrapur area of Nainital district colonies of all four species were observed ; those of *P. philippinus* in bushy trees over ditches, streams, and rivers, *P. megarhynchus* mainly in *Salmalia* trees (Ali & Crook loc. cit.), *P. benghalensis* in grassland near flood pools and fish tanks, and *P. manyar* in reed and rush beds over swampy pools and in rushes over flood water. Mixed colonies of *P. benghalensis* and *P. manyar* occur both in rushes in swamps and in grass near flood pools, normally with one of the two species predominating. Thus, while differences in colony siting are apparent, the overall environment of the species is the same. All species are gregarious and it is probable that in winter, when the males lose the bright nuptial dress, the three smaller species flock together in search of food. *Ploceus megarhynchus*, much larger and with a massive bill, probably moves separately, and certainly exploits different food supplies although the degree of overlap in preferences remains unknown. All these birds are seed eaters, the smaller three in particular being granivores. In the monsoon season there is a fairly clear concentration of each species around their nesting colonies and this tends to promote some degree of ecological segregation. Females of *P. philippinus* have, however, been seen visiting colonies of both *P. benghalensis* and *P. manyar*, and the country is in general so homogeneous and the individual nesting habitats so interlaced that there is ample opportunity for interspecies communication. There are considerable differences in both nest form and site between the species. The Baya suspends its nests with long tubular entrances from the twigs of trees and bushes. *P. benghalensis* fixes its tubed nest to a wad of rushes passing through the fabric at the upper end of the structure. *P. manyar* builds a similar nest supported by the long leaves of rushes (*Typha*), which are often bent down and woven into the structure for the purpose. *P. megarhynchus* usually places its vast globular nest, with an entrance at the side near the top, in the terminal twigs of tree-tops but sometimes among reeds (*Phragmites*) standing in water.

c. Field methods

The party consisted of Dr. Sálim Ali, Mrs. Eirene Harvalias Crook, the author and, for much of the time, Shri S. S. Bahadur, Wild Life Warden, Western Circle, U.P. We began work on July 10th 1959 and left the area on August 8th. Dr. Sálim Ali had to leave on July 23rd by which time the pattern of investigation had been well established. The original base of operations was Fatehpur (an excellent rest-house some 10 miles from Haldwani) and from here preliminary surveys were made. The later more detailed study, particularly of behaviour, was based on the Forest Rest House at Lalkua. The country was toured by car with additional trips into the forests on elephant back arranged by Shri Bahadur.

The colonies were studied from very close quarters, and the detailed movements of the birds observed with × 8 binoculars and when necessary with a × 21 telescope. The data recorded in the diagrams were taken down directly on tape using an EMI field tape recorder.

II. NEW OBSERVATIONS ON TWO WEAVER SPECIES IN INDIA

a. *Ploceus benghalensis*

Geographical distribution. The species, of which only the nominate race has been described, is restricted to the northern regions of the Indian sub-continent from the East Punjab and Sind to eastern Assam, Sylhet, and Manipur. In western India it is found as far south as Baroda and there is a record from near Bombay (Hume 1890), but it is most common in the flat low-lying country of Bengal, Bihar, and the Ganges plain. It has not been seen in Burma. In most of its range it is local and capricious (Stuart Baker 1926).

Ecology. Ploceus benghalensis is essentially a bird of the plains and lower hills though it has been recorded breeding in a tea estate at 4000 feet (Baker 1926). Its common habitat is open country, grass covered and liable to monsoon flooding. The breeding colonies are placed in elephant grass or 'moonj' (*Saccharum munja*), often close to or standing in flood water. The colony studied most closely in Kumaon was built in tall grass on a bank overlooking a fish culture tank, some of the nests leaning out over the water itself. All were easily approached along the bank by passing carefully through the high grass that hid the colony from view on the landward side. On July 21st 1959, there were eight territories each with several nests, but later the number increased. At another colony there were seven nests in a patch of moonj reeds standing in a shallow pool. At a further colony some birds were nesting in rushes and grasses over water in association with *P. manyar*. Two records from Bengal describe nests in low bushes over water on river or stream banks.

Nests, sex ratio in the colony, eggs and clutch size. The nests are finely woven unlined structures extremely similar to those of *P. philippinus* (Ali 1931, Ali & Ambedkar 1957, Crook 1960c). The fabric is identical except that it is not thickened to so great an extent by repetitive weaving. The structures are attached to upright grass stems woven tightly together by much stitching and entwining to form the wad base of the nest. The top of the nest is flat or dome-like, unlike the long thin supporting 'neck' of the Baya's structure. The male alone weaves and the entrance tubes may vary greatly in length, many being over a foot long. The nests are grouped into twos and threes at different stages of construction and each group is the work of a single male. When first observed (July 21st), the colony consisted of eight territories containing helmet stage nests, completed nests, and several ruined nests some partially constructed. All the old ruins had been abandoned and presumably represented an earlier attempt at breeding during one of the brief rainy spells that precede the monsoon proper. By July 25th each territory held several new structures many only a foot apart. While males were interested primarily in the latest nest they also maintained the earlier structures by 'titivating' them and, while primarily courting females near the latest structure, they also welcomed with greeting postures females already established. Polygamy was confirmed; several males having two nests occupied by females in their respective territories. As in the Common Baya the number of nests available for occupation is greater than the number occupied, and the number of females to a male perhaps varies from individual to individual and from year to year.

The eggs were white and their measures all fell within the range given by Stuart Baker (1926). Of 21 clutches examined in Kumaon in 1959 4 were c/5, 2—c/4, 12—c/3, 2—c/2, and one c/1. The mean thus is 3.25 eggs per clutch for the sample.

Territorial Behaviour. Three types of territorial defence were observed : supplanting attacks, head forward threats, and singing. Males move about the colonies outside their own territories a great deal particularly when following prospecting females, which fly from one territory to another on their visits. As soon as a territorial boundary is infringed the owner supplants the intruder and chases it away. Sometimes supplants lead to brief aerial combats. When two males are near one another between their respective nest groups 'head forward threats' occur. The birds flick their wings, turn towards one another with lowered heads and beaks pointing at the opponent, and hop about eyeing one another. These encounters are, however, brief and do not culminate in protracted 'threatening matches', 'aggressive dances', or 'song bowing' encounters such as have been described for some African ploceines (Crook 1959, 1962, in press). Female intruders are usually courted, but may be threatened or supplanted, particularly if another male intrudes at the same time. The males frequently perch upright on grass stems near their nests and sing. The song is however so soft that it is almost inaudible to the human observer only a few yards away.

Courtship. The male *P. benghalensis* leave the dry season flocks before the females and establish nests and territories in the colony. They continue to forage and to roost with the females, and retain intact the flocking responses of the breeding season. There is evidence to suggest that, as for *P. philippinus* in the Bombay-Poona area, several false starts are made at breeding as soon as the rain falls at the onset of the monsoon. Breeding activity slows down and stops if the rainfall is not maintained, and only develops fully when the rains are well under way. Thus half constructed nests and abortive courtships are seen at a few localities where, a few days later, the nests are abandoned. Later still, renewed activity at the same spot culminates in breeding.

At the start of breeding the males keep strictly to their territories, building nests and supplanting intruding neighbours. The females fly into the colony, usually singly but occasionally in small groups, and proceed to hop through the territories and to approach the various nests. Should the male be absent a female will alight in his nest, examine it, titivate upon it, and then hop on into the next territory. As soon as a male observes an approaching female he leaves his nest and flies towards her, often leaving his territory, alights close beside her, and gives an intense wing beating display during which he moves along the grass stem towards her. Most of these displays occur on tall grass stems overhanging water which usually bend to a horizontal position under the weight of the performing birds (Fig. 1). The posture of the male in this 'Upright Wings Beating Display' (UWBD) has the following components:

i. Wings beaten vigorously (mean speed 10 beats in 1.7 seconds n=21, Table I) fully elevated and extended above the back up to about 10 degrees from the dorso-ventral line of the body.

ii. Body plumage sleeked except for some fluffing of the nape feathers.

iii. Body crouched, oriented towards female.

iv. Tail straight, rarely raised, often fanned.

v. Beak turned down vertically so that the yellow crown faces the female.

vi. Song.

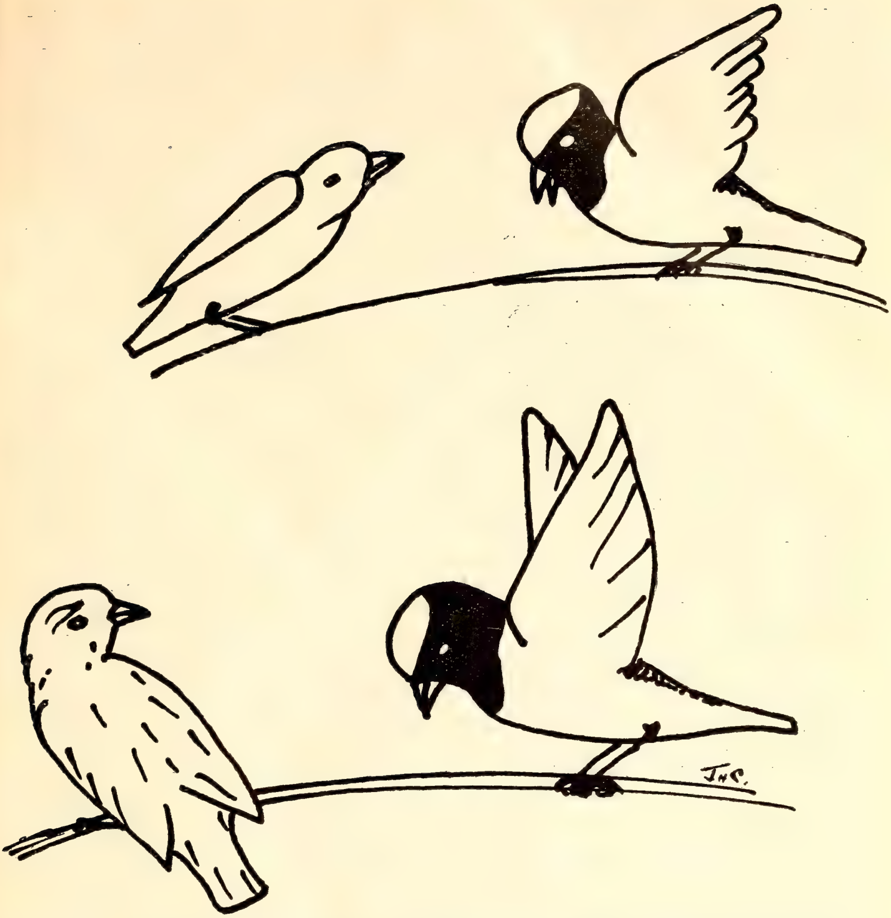


Fig. 1. Upright Wings Beating Display of male *Ploceus benghalensis*. Male on grass stem following close approach to female. Two field sketches.

TABLE I

Wing beating speeds of *P. benghalensis* and *P. manyar* during Upright Wing Beating Displays. Stopwatch accurate to 0.1 seconds

Time in seconds for 10 wing beats	*P. benghalensis* (n=21)	*P. manyar* (n=7)
2.0-2.1 seconds	4	5
1.8-1.9 ,,	4	2
1.6-1.7 ,,	9	—
1.4-1.5 ,,	3	—
1.2-1.3 ,,	1	—
Mean time for 10 beats	1.7 secs.	2.0 secs.

N.B.: The mean time for *P. philippinus* is 10 beats every 1.8 seconds (Crook 1960c) (n=25).

The female crouches, somewhat sleeked but otherwise appearing unconcerned, until the male is very close to her. She then either hops a short distance away, flies a short distance, or pecks fiercely at her suitor. The latter may pause a moment before commencing his display again. If the female has flown some distance the male flutters after her, and, unless chased off by some territory owner upon whose defended area he has trespassed, again begins the wing-beating approach. This sequence is often repeated several times before the female flies out of the colony with the male in swift pursuit. They may fly for more than a hundred metres from the colony but eventually the female lands. The male alights near her and, on some occasions at least, again approaches her in display. Sometimes, however, he tires of the chase, alights some distance from the female, and then returns alone to his nest. The female is, however, clearly attracted by her pursuer for, commonly, as the male begins his return flight, she, without having landed, turns in flight and follows him swiftly to his nest where the familiar approach sequence is again performed. Sometimes during the return flight, if the female wavers, the male will turn again and start to chase her until she swings around once more and follows him to his territory. After several such chases the male often wing-quivers intensely in the presence of the female who now repeatedly hops on to the developing 'initial ring' (Skead 1947) of the nest. Often, after a bout of wing-beating approaches and mutual hopping about in the territory, the female goes to the nest and the male rushes to the nest entrance and performs an intense Upright Wings

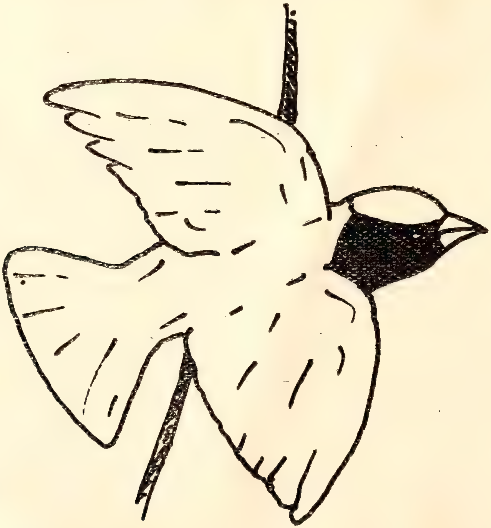


Fig. 2. Upright Wings Rigid Display of *Ploceus benghalensis*. Wings outstretched at side of body in the plane of the back and held motionless. Tail extremely fanned. Bird facing female in or near nest.

Beating Display just outside. At moments of high intensity the wing-beating changes to 'wings rigid', recalling similar changes in the composition of the Advertisement displays of *P. cucullatus* and *P. philippinus* (Crook 1960c, and in press).

The 'Upright Wings Rigid Display' (UWRD) has the following composition :

i. Wings fully spread and stretched out to full extent on either side of the body (at 90 degrees to the dorso-ventral line). They are quite still and have an appearance of rigidity.
ii. Body plumage sleeked.
iii. Body not crouched, bird usually hopping about.
iv. Tail widely fanned and straight.
v. Beak not turned down, usually oriented to female, but the head is not retracted into shoulders as in preparatory movements of lunging.

As the female leaves the nest the male commonly hops about the territory in this posture with her.

The female solicits the male either in the nest entrance or in the grasses below the nest. Her posture is a simple crouching accompanied by tail vibration in the vertical plane and wing-quivering. The male normally mounts at once. Frequently, however, in the course of these sequences the female attacks the male, particularly after he has made a close approach in the Upright Wings Beating Display posture. No pseudo-female solicitation has been recorded for the male.

A total of 71 courtship sequences were closely observed and recorded in detail on tape. These are presented in Diagram A which thus summarises the data and shows the frequency with which the various responses occurred. Altogether only 11.2% of all sequences included copulations or attempted copulations, whereas 32.3% included aggression from one sex or the other. In one case only did the male succeed in copulating when the female had previously lunged at him in the same sequence. Normally, only those sequences in which neither sex showed aggression ended in copulation. Most of the attacks were made on the male by the female (18/23 of sequences containing aggression) usually following the close approach of the former. Only 6 actual attacks on females by males were seen. Copulation normally followed intense wing-quivering which in all weavers indicates a strong tendency to respond sexually (Crook 1960b, c, and in press). In only 2/8 copulations did the response follow the Upright Wings Beating Display directly without an interim period of wing-quivering usually performed mutually. There was one anomalous response in which the male both sang at the female and wing-quivered to her. These data may be compared with those of *P. manyar* in Diagrams B and C and those of *P. philippinus* in Crook 1960c (Table V).

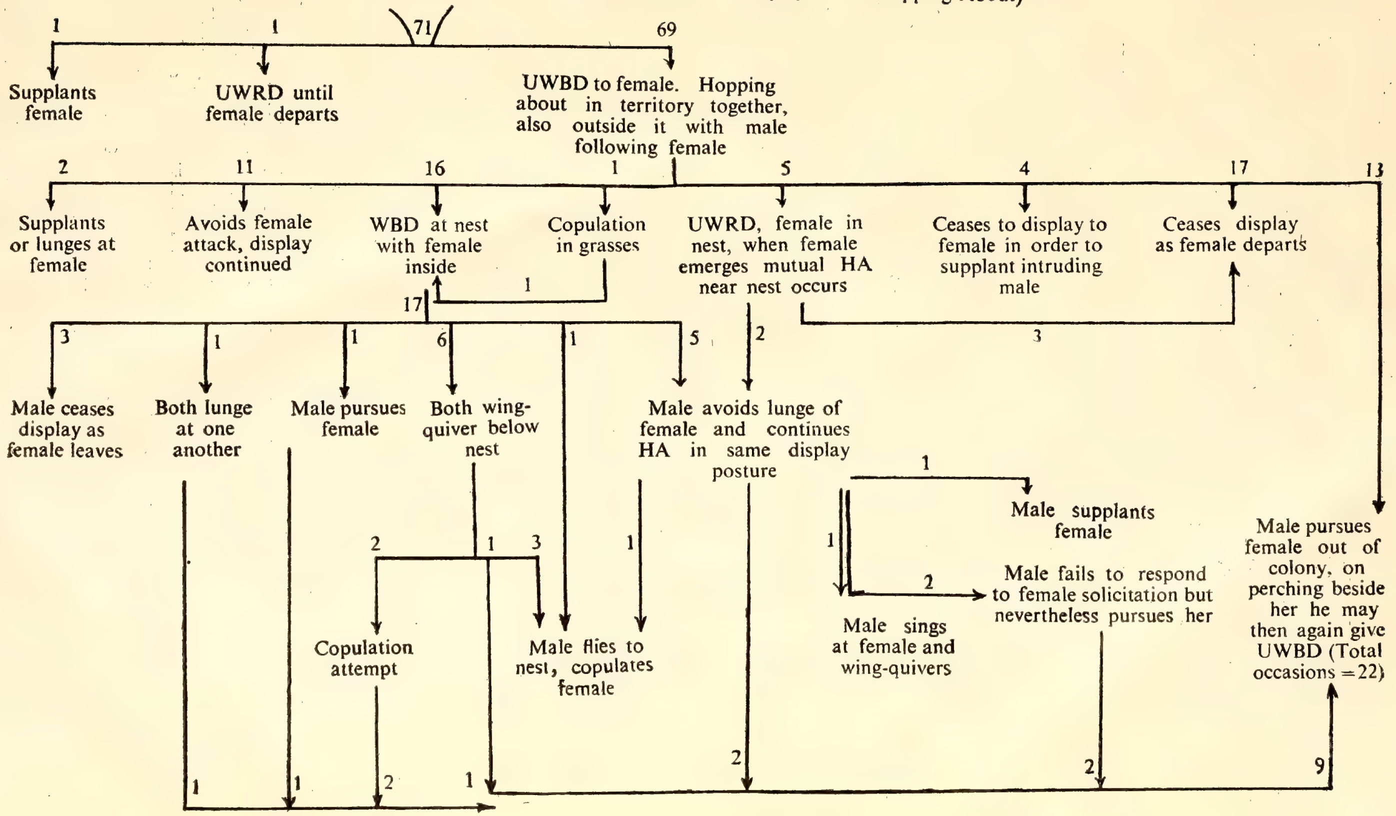
Vocalisation. Soft *chit chit* calls are given by birds flying into the colony. These appear to help in the orientation of the female to the male during the return flight to the nest. The soft, barely audible song *tsi tsi tsisik tsisik tsik tsik* 'like the chirp of a cricket or the subdued short squeaks of an unoiled bicycle wheel' (Sâlim Ali, in litt.) is given during the UWB approaches to the female and also by males sitting solitarily within their territories. The extreme softness of the song, an anomaly among Ploceines, correlates with its utterance from a mere inch or so from the female to which it is given. The function appears to be courtship rather than advertisement (cf. *P. manyar*). In the alert 'song posture' when the male sings solitarily in his small territory there may be some advertisement significance for the neighbouring males close by. It is clear, however, that the contrast in loudness of song between this species and *P. philippinus* and *manyar* is due to its production at close quarters to the female [cf. Estrildid song (Hall 1962)].

b. *Ploceus manyar*

Geographical distribution. Three races of *P. manyar* are accepted at the present time. The nominate, *manyar*, extends throughout the islands of Java, Bali, and Bawean, *P. m. peguensis* occurs from Annam, Yunnan, Siam, Burma, and Assam into the Ganges Valley ; while *P. m. striatus* (with which the former race *flavipes* is now merged) is found from NW. India through S. India to Ceylon. The distribution of the species is thus not only as great as that of the Common Baya, *P. philippinus*, but regional differentiation into races has similarly occurred. The range of the two races in northern India overlaps that of *P. benghalensis* the two species being, so far as is known, entirely sympatric within the range of the latter.

Ecology. Ploceus manyar inhabits flat swampy and rain-flooded lands in India and SE. Asia. In north India it shows a preference for swampy areas covered by rushes or reeds over standing water and colonies are normally so situated. In this it contrasts with *P. benghalensis* in the same area which tends to occupy grassland alongside flood water. *P. manyar* is locally distributed in most of peninsular India and Burma being limited to sizeable areas of swamp country. In the Ganges Valley and in Bengal colonies of some 40-50 pairs are usual, but in Sind and Punjab, where suitable tracts of reed-covered swamp are more restricted, it often breeds in very large colonies and Hume once found about 100 nests on a small bulrush island not twenty yards in diameter. Occasionally the species has been seen breeding in thorny bushes overhanging water (Hume 1890). Spennemann (1926) and Delacour (1947) write that in Java the nominate race nests in large colonies in bushes, trees, or palms, often near houses and usually over water, and it is common

DIAGRAM A. Behaviour sequences of male *Ploceus benghalensis* on the appearance of females in or near the territories. Total number of sequences observed 71. (UWBD—Upright Wing Beating Display, UWRD—Upright Wings Rigid Display, HA—Hopping About)


71
1
1
69
Supplants female
UWRD until female departs
UWBD to female. Hopping about in territory together, also outside it with male following female
2
11
16
1
5
4
17
13
Supplants or lunges at female
Avoids female attack, display continued
WBD at nest with female inside
Copulation in grasses
UWRD, female in nest, when female emerges mutual HA near nest occurs
Ceases to display to female in order to supplant intruding male
Ceases display as female departs
1
17
3
1
1
6
1
5
2
3
Male ceases display as female leaves
Both lunge at one another
Male pursues female
Both wing-quiver below nest
Male avoids lunge of female and continues HA in same display posture
1
Male supplants female
2
1
3
1
1
2
Male fails to respond to female solicitation but nevertheless pursues her
Male pursues female out of colony, on perching beside her he may then again give UWBD (Total occasions = 22)
Copulation attempt
Male flies to nest, copulates female
Male sings at female and wing-quivers
1
1
2
1
2
2
9

in a variety of terrain including reed beds, open grassy country, rice fields, and lowland gardens.

In Kumaon, colonies were situated in reeds or rushes over muddy pools in the tarai grassland, all in close proximity to colonies of *P. benghalensis*, *P. philippinus*, and *P. megarhynchus*. The colonies varied in size from 3-4 nests up to about 30. Three particular sites were watched during the visit.

Nests, sex ratio in the colony, eggs and clutch size. The nests of *P. manyar* are normally suspended from the tips of rushes or reeds usually bent down and incorporated into the wall of the structure (Fig. 4). The nests are 2-3 yards apart, at the closest one yard and in the most dispersed colonies about 6 yards. The structures are more coarsely woven than the nests of either *P. benghalensis* or *P. philippinus* and the top of the nest is rounded and not extended into flanges of weaving along the supporting reeds. The coarseness of the fabric is due to the use of strips of greater width for building than in the other two species. The tubular nest entrance is rarely developed much beyond the level of the bottom of the egg chamber floor in Kumaon, but in Java Delacour (1947) states that long tubes are made. This correlates evidently with siting in trees there.

The species is commonly monogamous. In one colony in Kumaon in 1959, groups of 5 and 3 nests respectively were closely observed and each nest was found to belong to a single male. This condition remained unchanged throughout the period of observation. In a large colony of 30 nests male *manyar* were never observed to visit more than a single structure except during occasional attempts to steal material. In no case was a male observed constructing a series of nests in the manner of *P. benghalensis* or *P. philippinus* in the same area. In addition in two nests males were seen incubating, an activity not recorded from polygamous male weavers and, in a mixed colony with *P. benghalensis*, males of the latter species continued courting and chasing females long after the male *manyar* had ceased to do so—although the nests of both species had been established at the same period. There are suggestions, however, that sometimes the species may breed polygamously. Thus, although Spennemann (1926) described monogamy in Java, Delacour (1947) says the species is polygamous there. In addition Sálim Ali (personal communication) saw a single male with three nests at different stages all being maintained at once at Shamshabad in the Deccan in 1952, and in Kumaon he recorded two cases of males building a couple of nests each with courtship occurring at both structures.

The eggs are white. Some measurements exceed those of Stuart Baker (1926) made in south India (maximum length 21.6 mm., minimum 19.2, maximum breadth 15.1, minimum 13.1). The maximum length of

Kumaon sample of 16 eggs was 22.6 mm. with a minimum of 20.2, maximum breadth 15.5 with minimum 14 mm.

Of 7 clutches examined in Kumaon in 1959 1 was c/4, 4—c/3, 2—c/2, and none c/1. Ali (in litt.) in Travancore in 1933 recorded 1—c/3, 3—c/2, and 1—c/1. From these 12 clutches therefore the mean clutch size for the species is 2.85 eggs. Further figures may substantiate the slightly larger clutch size from the more northern population.

Territorial behaviour. The only aggressive behaviour observed between the males was an occasional supplant easily dodged by the offender. Trespassers over territorial boundaries were treated in this way but, compared with *P. benghalensis*, there was much less territorial infringement and this correlated with the different mode of pair formation of the latter in which the males fly out at females, and thereby enter other territories, much more frequently.

The males further advertise their territories by a loud and remarkably attractive song given when sitting solitarily on a conspicuous perch near or on the nest. This song undoubtedly emphasises territorial claims. Further, when females begin to arrive, the males perform Upright Wing Beating Displays near their nests often in social facilitation with one another. These mass performances undoubtedly make clear the position of defended areas to other males as well as the sites of potential nests to females.

Courtship. As in other Ploceines the males leave the flocks before the females and establish nests in territories in their colony sites. Flocking responses likewise are retained away from the colony itself. As soon as the nest sites are established the males respond to the arrival of other individuals, male or female, with dramatic Upright Wing Beating Displays. These are, moreover, given at the nests and do not follow a flight towards the female during her approach as in *P. benghalensis.* Approaching birds can be heard for a considerable distance and emit loud *chirt chirt chirt* calls continuously over a distance of at least 100 yards as they fly into the colony. This appears to alert the colony and coincides with the start of display by some of the males, display rapidly taken up by others through social facilitation. As soon as the females enter the colony they pass rapidly to the nests or territories of displaying males. The Upright Wing Beating Display, performed either on the nest or, more frequently, on rushes near it, has the following composition :

i. Wings fully raised above the back at about 45 degrees to the dorso-ventral line of the body and beaten vigorously (mean speed 10 beats in 2 seconds, n=7, Table I).

ii. Body plumage normal, not markedly sleeked.

iii. Body upright, usually oriented to approaching birds or the female.

iv. Tail straight, sometimes a little fanned.

v. Beak neither turned down over chest nor pointed at female aggressively.

vi. The bird calls *tre tre cherrer cherrer* repeatedly when performing in unison with other males, but in courtship to the female he sings a slightly curtailed version of the song.

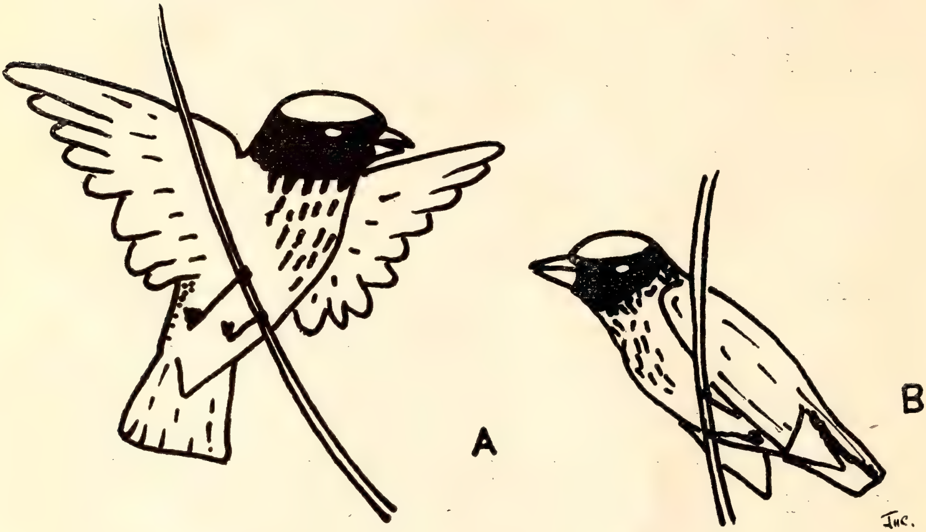


Fig. 3. A. Upright Wings Beating Display of male *Ploceus manyar*. B. Wing quivering of male *Ploceus manyar* to female in or near nest.

If a female enters the colony unnoticed she slips quietly into the territory of her choice, where the male greets her by going to the nest structure and performing the Upright Wings Beating Display. Often, however, the male supplants the female and chases her out of the colony. In the territory the female moves about into and around the nest in a 'sleeked' nervous posture while the male hops about in the display posture frequently singing, especially when she has entered the nest. Sometimes the male's display assumes the form of an Upright Wings Rigid posture with the wings held out on either side at about 90 degrees to the dorso-ventral line and quite still and rigid. He then sings loudly to the female who is usually in or emerging from the nest. When the female leaves the territory the male pursues her well beyond the colony following her flight manoeuvres closely. When she alights he comes down near her and quivers his wings in continued courtship after which he leads her back in swift flight to his territory turning to follow her at once should she diverge from the flight line. On arrival he at once goes to his nest, perches in the initial ring, and, as the female arrives in the territory behind him, he gives an intense ‘ pseudo-female solicitation’ display with body crouched, wings drooped and tremored, and tail tremoring at high speed in the vertical plane (Fig. 4). The female then hops into the nest, the male emerges and usually attempts to mount her. At this she frequently flees and a further long chase follows until both return again calling the loud *chirt chirt* approach cry as they come in. When the female is receptive she solicits copulation, often as soon as she has arrived at the nest, in a crouched posture with quivering wings. Copulation occurs in the nest entrance or in vegetation near or below the nest.

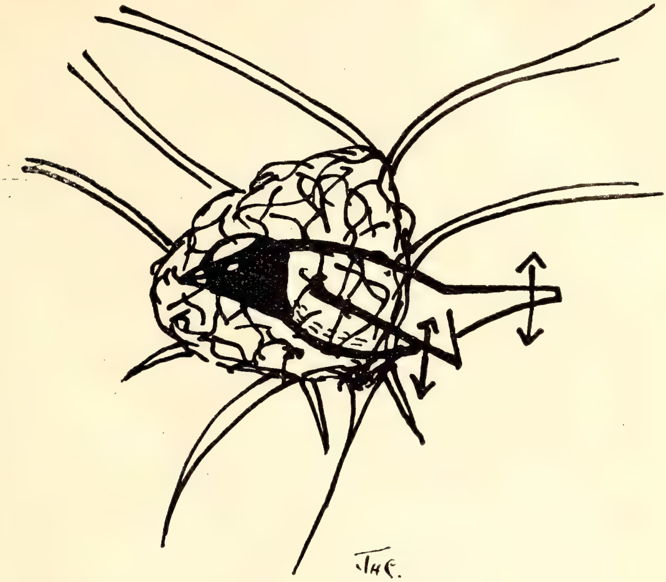


Fig. 4. Male *Ploceus manyar* giving pseudo-female solicitation in nest entrance of fresh incompleted structure.

During pursuit flights several males may join in the chase and, in general, competition between males for females is very considerable. Males sometimes zip into another's territory and attempt a stolen copulation as soon as the rightful male dismounts—a particularly fine piece of timing it would appear. Dr. Ali has also seen neighbouring males copulating, apparently successfully, with a single female during her visit to the colony.

In Diagram B, 19 sequences of early courtship during the first approaches of females to territories are shown. These are marked by displays near the nest and, if the female is receptive, attempts at copulation. In Diagram C, 26 later sequences depicting events following sex chases away from the colony are shown. Here the male performs pseudo-female solicitation and attempts copulation when the female has perched in the nest entrance. In 5 sequences (heading B) he sang aggressively at the female after which she usually fled. If the female leaves the nest the male usually returns to it again and performs further pseudo-solicitation. 10/16 copulations in Diagram C occurred in the nest entrance, others below the nest in the reeds. Copulations in Diagram B likewise occurred in the nest ring. Only 29% of all sequences contained marked aggression while 47.1% ended in copulatory behaviour (Table IV). It is concluded that in courtship the species is much less aggressive than *P. benghalensis.* There are no records of female *P. manyar* attacking males and this clearly correlates with the absence of Wing Beating approaches. Finally pseudo-female solicitation indicates a conflict state in which sex and escape tendencies are active rather than the tendency to attack. This posture, common in *P. manyar*, has not been seen during the courtship of *P. benghalensis.*

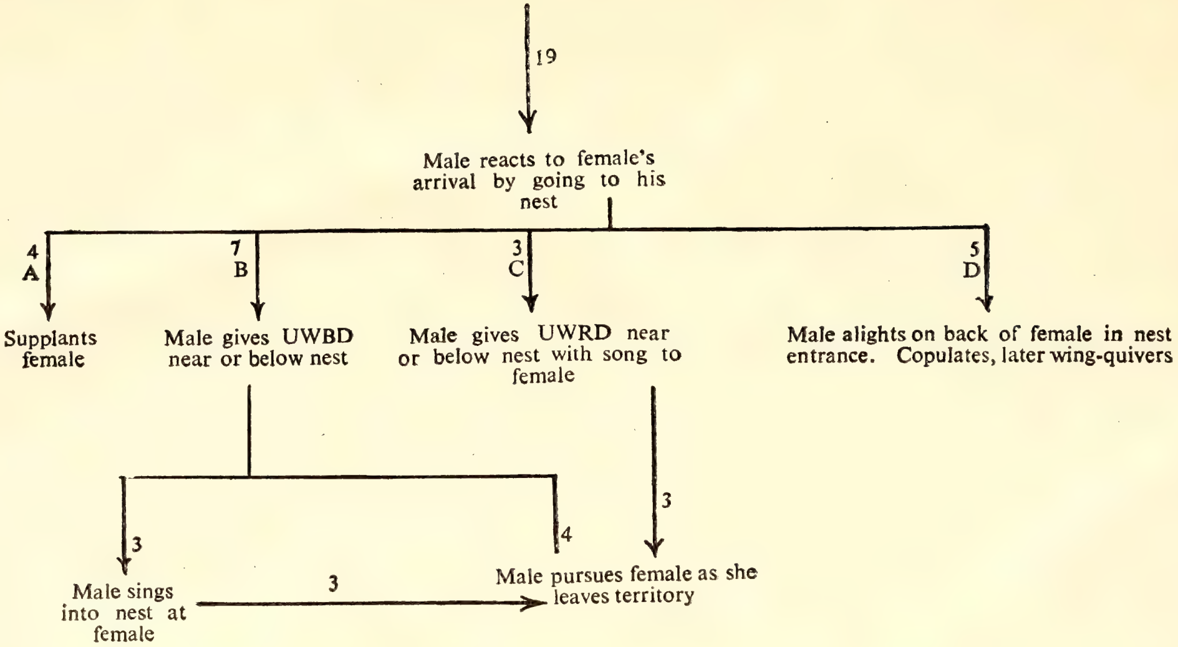
Vocalisation. Vocalisations include : (i) the *chirt chirt* cries on approaching the colony, (ii) the *tre tre cherrer cherrer* calls in repetition during Wing Beating Display, and (iii) the song.

All these cries are louder and more emphatic than similar cries produced by *P. benghalensis.* The song is clearly aggressive though the tendency to attack is balanced by conflicting tendencies to retreat, remain near the nest, or to behave sexually, depending on context. Often, in company with the female, wing-quivering occurs with song indicating a strong sexual tendency. Even when song is clearly threatening, the female rarely abandons the territory completely but merely flies away and later returns with the male which has pursued her. Both the threatening and the chasing are probably highly stimulating to the female (Hinde 1953) and are an integral part of courtship although the initial chases are clearly more in the nature of supplanting attacks than sexual pursuits. Again copulatory behaviour commonly follows the return from a pursuit. The song which is charmingly musical, contains a long trill of about six notes (*tsi tsi* etc.) culminating in a long drawn wheeze. It is apparently not sung in choruses like the baya. It may be rendered *Tzrr we tsee tsee tsi tsi tser cheeze we.* It is often shorter when given to the female in courtship.

At times the males give a variety of chirring sounds particularly as a party arrives in the colony and each bird separates to his nest. The cry is apparently aggressive.

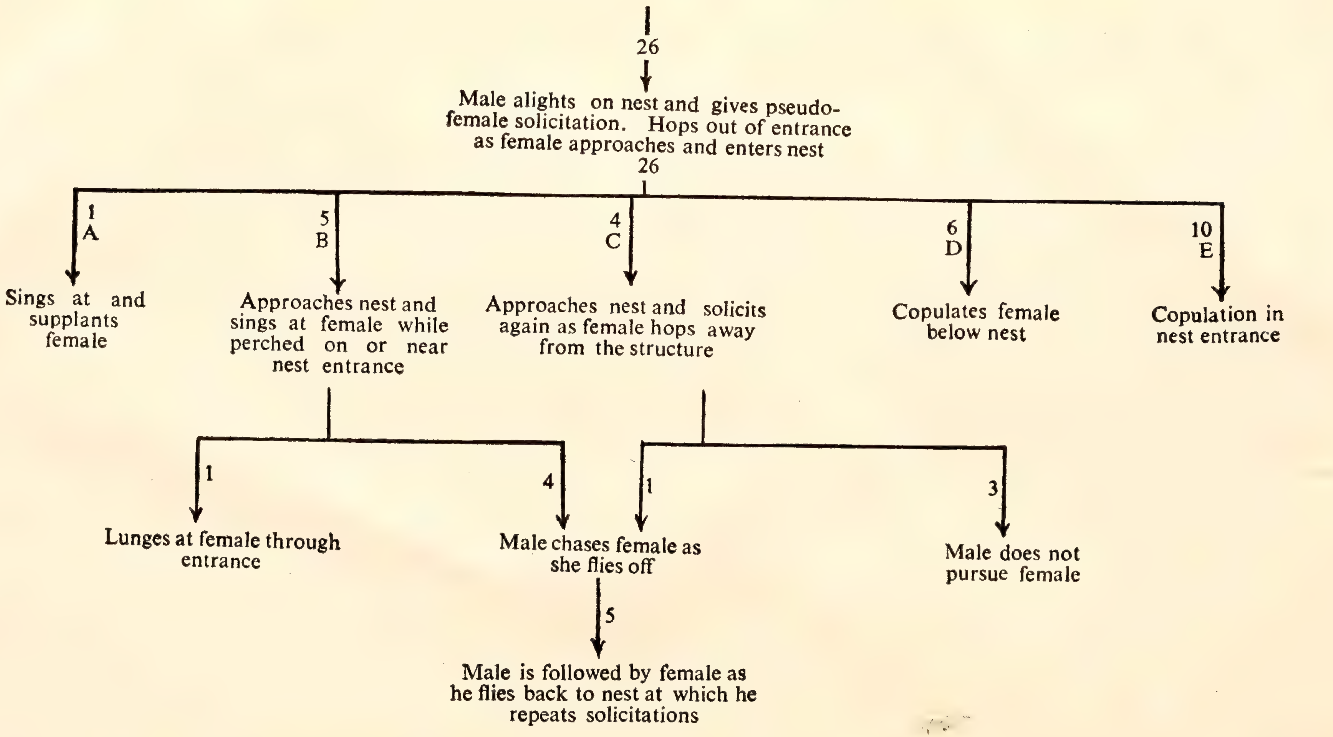
During mounting attempts the male flutters about after the female calling *chewe chewe chewe* repeatedly. When the female is soliciting she gives a very thin repeated piping call.

DIAGRAM B. Behaviour sequences of male *Ploceus manyar* in the territory following the arrival of a female on the nest either after her solitary entrance to the territory or after a pursuit flight. These sequences occur during the initial visits of females to the colony.


19
Male reacts to female's arrival by going to his nest
4 A
7 B
3 C
5 D
Supplants female
Male gives UWBD near or below nest
Male gives UWRD near or below nest with song to female
Male alights on back of female in nest entrance. Copulates, later wing-quivers
3
4
3
3
Male sings into nest at female
Male pursues female as she leaves territory

Female responses. In A, B, and C female remains sleeked, nervous. Finally she flies from the nest usually pursued by the male. Only in D does she solicit or permit mounting. Here the male does not display prior to an attempt at copulation.

DIAGRAM C. Behaviour sequences of male *Ploceus manyar* on arrival at the nest followed by the female. These sequences usually occur later in courtship than those shown in Diagram B.


26
Male alights on nest and gives pseudo-female solicitation. Hops out of entrance as female approaches and enters nest
26
1 A
Sings at and supplants female
5 B
Approaches nest and sings at female while perched on or near nest entrance
4 C
Approaches nest and solicits again as female hops away from the structure
6 D
Copulates female below nest
10 E
Copulation in nest entrance
1
Lunges at female through entrance
4
1
Male chases female as she flies off
3
Male does not pursue female
5
Male is followed by female as he flies back to nest at which he repeats solicitations

Female responses. She follows the male into the territory, perches near nest and wing-quivers. She then approaches it and sits in entrance. If male performs A or B she flees but may return if male pursues and leads her back to the territory. After C she hops away and returns as male solicits; she then flies off. In cases D and E she solicits the male while he is likewise soliciting or wing-quivering. Copulation then follows.

III. PROBLEMS OF PLOCEINE SYMPATRY IN ASIA, WITH PARTICULAR REFERENCE TO THE TARAI

Evaluation of the extent of competition and reproductive isolation between closely related species in the same area depends upon a detailed knowledge of the relevant ecological and behavioural variables. The existing information may be summarised under headings : (i) habitat selection, (ii) food selection, and (iii) mate selection. Differences in habitat and food preferences clearly reduce the likelihood of competition while in addition the habitat contrasts reduce the frequency with which species encounter one another in the breeding season and thus reduce the likelihood of attempted hybridisation. Contrasts in behaviour occurring in mate selection tend to inhibit pairing and prevent hybridisation.

Throughout the discussion it will be clear that differences in size, colour, beak proportions, and behaviour set *P. megarhynchus* apart from the other Indian weavers. Only *Ploceus hypoxanthus*, for which there is regrettably little information, appears to have some significant resemblances to *P. megarhynchus*. A general comparative summary of the relevant characteristics is provided in Tables II and III.

a. Habitat Selection

Differences in habitat preference are important in reducing ecological competition and the frequency of opportunities for hybridisation. In general *P. philippinus* is found in drier areas than either *P. benghalensis* or *P. manyar* and shows a strong preference for agricultural land rather than extensive grasslands or swamps. Furthermore, it requires trees, commonly in protective sites near water or around habitation, in which to construct its nests. Even in the arid Deccan the species appears locally wherever agriculture is permitted by the presence of seasonal streams or wells, over which the nests are commonly built. The nature of the bird's habitat suggests that prior to the establishment of widespread farming in India the bird was an inhabitant of damp ‘ savannah ’, nesting in colonies in trees over water. By contrast *P. manyar* requires extensive swampy areas and *P. benghalensis* the wet often seasonally flooded grasslands of the tarai. Both species place their nests low down in rushes (see further below) and grass respectively, and not in trees. At higher elevations only *P. philippinus* occurs ; for instance it is the only weaver in the Valley of Nepal.

In the tarai all three habitats, agricultural land with streams and a sprinkling of trees, patches of swamps, and extensive grass plains interdigitate tightly within the same general environment and the three species breed in adjacent, occasionally mixed (*P. manyar* and *P. benghalensis*), colonies in which, however, one species is normally in the majority. In

TABLE II

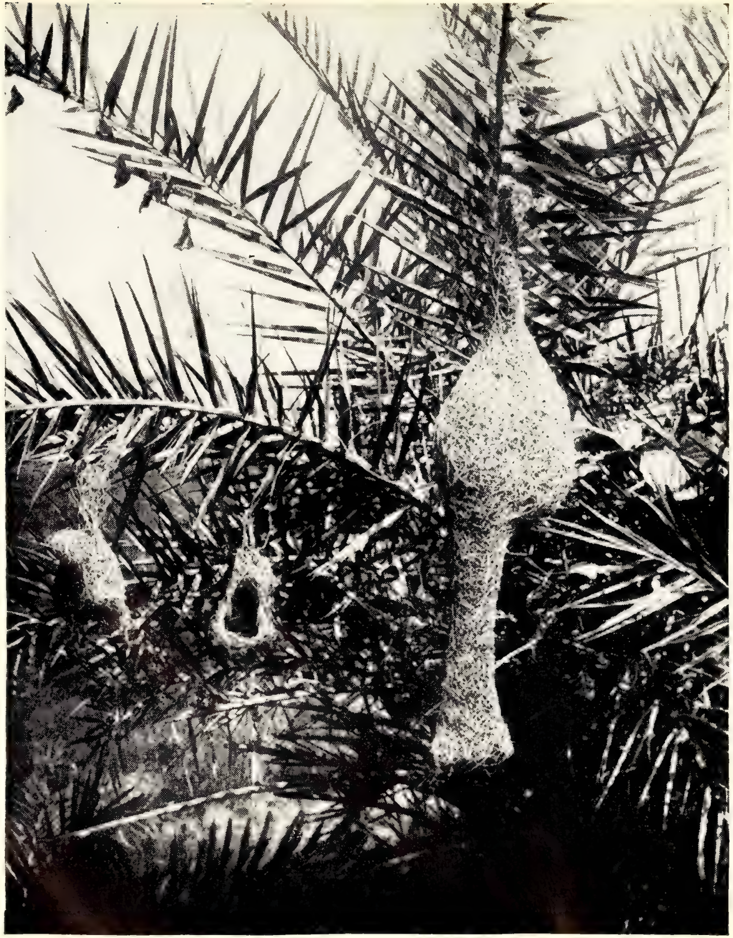
SUMMARY OF GENERAL CHARACTERISTICS OF ASIAN WEAVERS

	Ploceus philippinus	*Ploceus manyar*	*Ploceus benghalensis*	*Ploceus megarhynchus*	*P. hypoxanthus*
Number of races	3	3	1	2	1
Habitat	Open country with agriculture and irrigation. Not in arid areas	Swamps, flood plains. Agricultural land etc. in Java	Grassy flood plains	Grassy flood plains with trees	Swamps, flood plains, Rangoon gardens
Colony site	Trees over water, vegetation over wells, palms, bungalow verandahs	Reeds, rushes, grass. Trees in Java	Grass beds, rushes	Tops of tall trees	Bushes in swamps etc.
Nest shape	Retort shape. Suspended or pendant	Retort shape. No neck. Short tube—longer in Java. Suspended	Retort shape. No neck. Suspended	Globular. Supported	Globular. Supported
Nest fabric, lining[1]	Fine weave. No lining. Mud blobs	Less fine weaving. No lining. Mud layer in some nests	Fine weave. No lining. Mud layer in some nests	Coarse weave. Lining. Mud blobs	Coarse weave. Mud etc.? Lining?
Pair formation	Inverted advertisement on nest precedes sex chasing	Upright WB near nest precedes sex chasing	Sex chasing with WB approach precedes visit to nest with female	Elaborate Advertisement display postures. No sex chasing. Courtship entirely within territory	

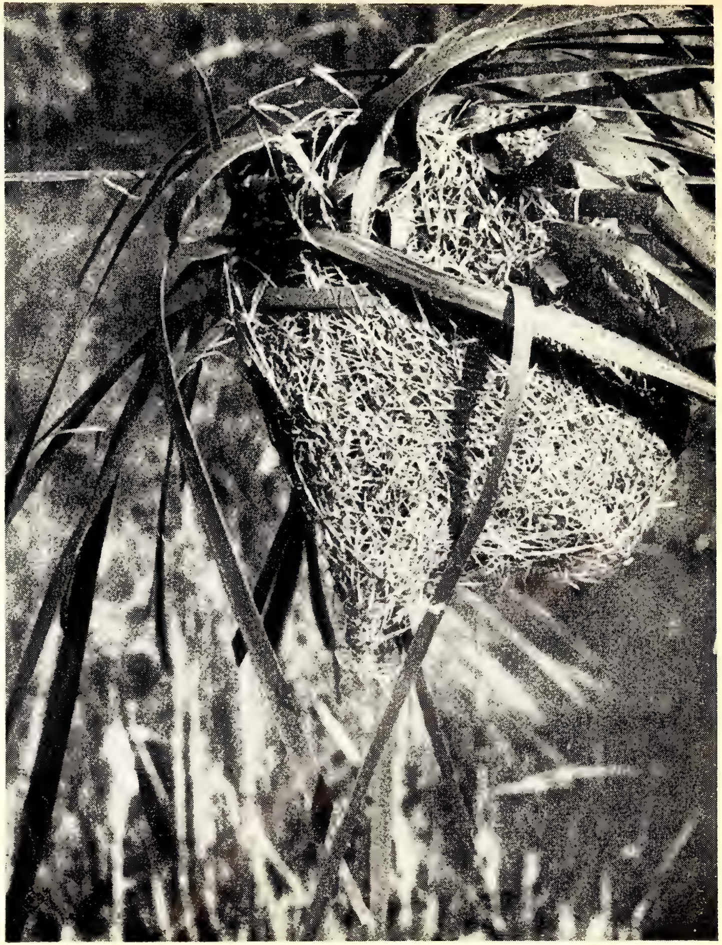
Notes : (*a*) All Asian weavers are seed eaters, primarily granivorous, taking insects in the breeding season to feed young. Diet of *P. hypoxanthus* presumed the same. All are gregarious, colonial, sexually dimorphic and in the male seasonally dimorphic (female *megarhynchus* too apparently). All except perhaps Kumaon *manyar* population are polygamous.

(*b*) The southern races of *P. philippinus* and *P. manyar*, i.e. those of evergreen environments, have richer, darker coloration than those of the more arid monsoon areas in northern India. Abdulali (1961) describes the colour differences between *P. megarhynchus* races—the birds from Assam being more yellow on underparts etc.

[1] A very small amount of soft material is brought in by the female and placed on the floor of the egg chamber. Only in *P. megarhynchus* is the male known to line extensively.

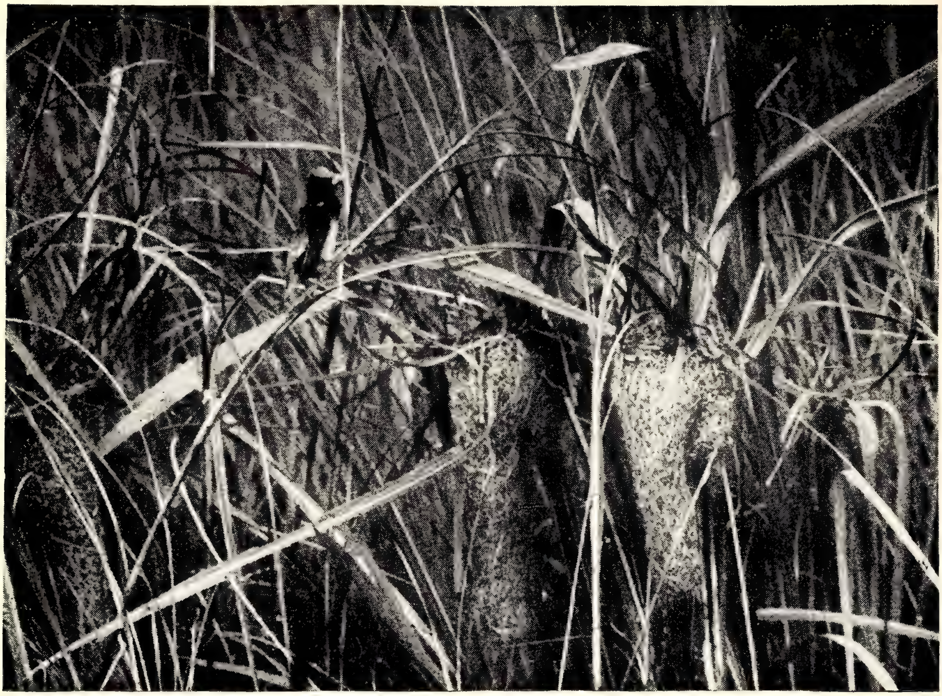


Suspended nest of *Ploceus philippinus*

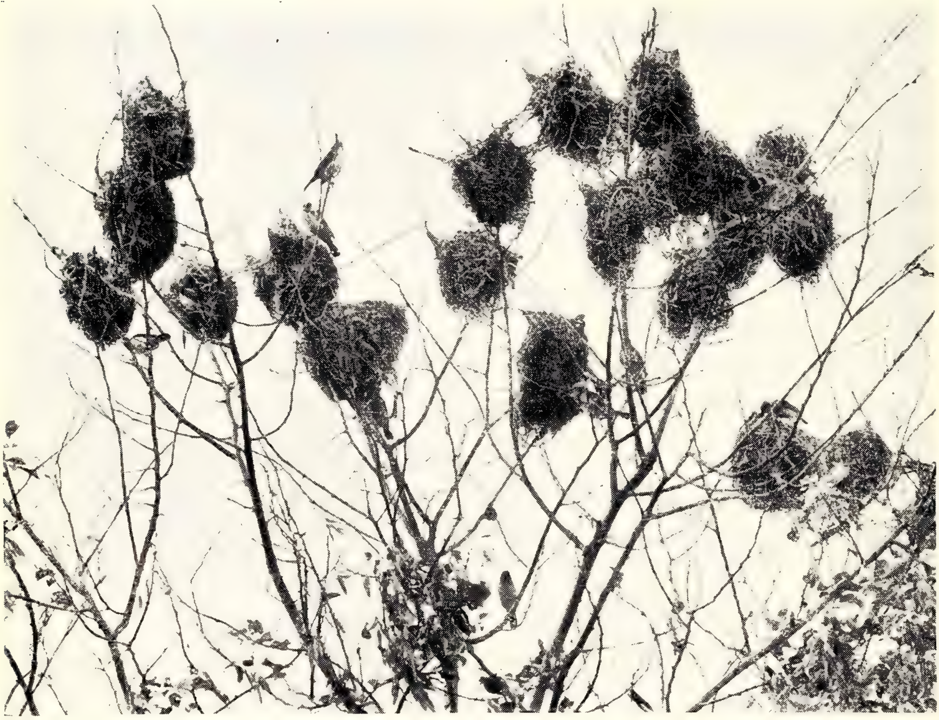


Nest of *Ploceus manyar* supported by rush blades (*Typha*)

Photos : Dr. Sálim Ali



Swampy grassfield nests of *Ploceus benghalensis*



Treetop nests of *Ploceus megarhynchus*
Photos : Dr. Sálim Ali

peninsular India both *P. philippinus* and *P. manyar* are widely, though often locally, distributed but only where extensive swampy places are found in river valleys or coastal plains are the two species likely to occur together. Both are found again in Ceylon with the same habitat preferences.

In south-east Asia there is a more complex picture. In Burma and Thailand *P. philippinus* and *P. manyar* occupy habitats apparently identical to those in India. In Malaya only *P. philippinus* occurs and this is restricted to gaps in the prevailing forests and to farming areas. *P. hypoxanthus* also occurs with *P. philippinus* locally in Sumatra but the latter is the commoner. In Java, where *P. manyar* reappears, *P. philippinus* again appears the commoner in coastal areas. *P. manyar* now occupies a habitat around farmed areas and plantations nesting in trees and bushes (Spennemann 1926, Delacour 1947) and thereby differing considerably from other populations elsewhere. It is commonly found at higher elevations than *philippinus* though there seems to be considerable overlap in altitudinal range. Hoogerwerf (1947), in a survey of the birds of contrasting localities in Java, found it not only at sea-level but also up to 1500 feet in the area of Buitenzorg (Bandung) while he records *P. philippinus* only between sea-level and 800 feet. Delacour (loc. cit.) furthermore reports that the *manyar* nests in trees have long tubular entrances. Thus, in Java, far from being a swamp dweller, *P. manyar* seems to inhabit precisely the same niche as *P. philippinus* but primarily at a higher altitude. In addition Spennemann (loc. cit.) describes a difference in breeding season between the two species.

P. megarhynchus occurs in the tarai and usually nests in the tops of trees near canals or roads. It is sympatric with the other three Indian species and ranges widely though patchily over their breeding areas. In Burma and Thailand *P. hypoxanthus* occurs in swampy marshy areas often together with other species, and reappears apparently very locally (it seems to turn up only rarely in bird lists) in Sumatra and Java, again in similar habitats.

There are of course profound differences in the vegetation of India and south-east Asia, for whereas the former suffers a monsoon climate with an alternation of wet and dry seasons, in Malaya, Sumatra, Borneo, parts of Burma, and Thailand climatic conditions change little throughout the year and much of the land is covered with vast expanses of tropical rain forest in which Asian weavers are never found. In Java there is a monsoon season and a widespread deciduous forest, the rain forest being limited to favoured areas (Richards 1952). In India the plains of the tarai in winter are bare and dry and limited observations suggest that at this time the habitat preferences of the weavers break down entirely and the three smaller species then flock together in a mutual search for food. In addition they probably undergo migrations along the Ganges

Valley. It is thus likely that the habitat contrasts in the northern areas are only operative during the breeding season. In more constant climates (Ceylon, Burma, Sumatra) breeding and habitat differences are maintained for much of the year. In Java nothing seems to have been recorded of seasonal changes in bird activity.

b. Food Preferences

While it is generally agreed that the Asian Ploceines are all seed eaters to date no critical study of the subject has been made. In Poona *P. philippinus* takes a variety of seeds during the dry season mostly from the ground around farms and, in the breeding season, in addition to attacking ripening crops of jowar (*Sorghum*), bajra (*Pennisetum*), and maize (*Zea*), it brings insect food in the beak for the young in the nest. Similarly *P. megarhynchus* brings insects in the beak for its young but otherwise takes seeds. Nothing is known of its food outside the breeding season. The massive bills of both *P. megarhynchus* and *P. hypoxanthus* suggest food supplies differing from those of other weavers.

The beak sizes of *P. philippinus*, *P. manyar*, and *P. benghalensis* are similar and this, together with similarities in body size and gregarious habits, suggests that they take similar foods (Kear 1962). In order to evaluate more precisely the similarities in beak sizes, measurements were made on samples of British Museum material and analysed statistically (Appendix). The results show : 1) the beak lengths of *P. manyar*, *P. benghalensis*, and *P. philippinus* do not differ significantly. 2) The beak depths of the same three species do not differ significantly. 3) The beak lengths and depths of *P. hypoxanthus* differ significantly from those of the other three species. 4) A consistent difference in bill length was found between the sexes of each species, those of the males being the larger. This sex effect appears to be the same for all four species. 5) A similar sex effect was found in the beak depths but here the difference between the sexes for *P. benghalensis* was much greater than for the other three species (see Appendix). 6) The sex effect is presumably due to secondary sexual changes in the beak of the breeding male and is probably not sufficient to have any differential effect on the food taken by the two sexes. The larger beak of the male may be of survival value in nest building.

These facts suggest that, unless the responsiveness to food objects differs between the three species, they must take seeds and perhaps insects of the same size range whenever they feed together in the same area. In the breeding season such habitat contrasts as exist in Kumaon will tend to aggregate the species in differing areas so that local supplies will, to some extent at least, be utilised by different species. If, as seems possible, the flocks join up in winter then the conclusion that they take the same food is inescapable. If this is so when the food supplies are insufficient to support the whole population competition between the individual members of the flock for the diminishing supply must occur. In such competition any individuals which through dominance or any other characteristic (such as faster ' follow up ' responses ensuring quicker arrival at limited food supplies found by the group) have an advantage over their fellows will tend to survive at their expense and ultimately replace them throughout the area. The result of such a process has been expressed in Gause's Law (Gause 1934).

There are, however, certain conditions under which sympatric species in the same niche can maintain their numbers in a balanced population. Such conditions are those of food ' superabundance ' (Lack 1954). Moreau (1948) has in fact suggested that competition between the species members of mixed flocks of weavers in Africa is prevented by the overwhelming quantity of grass seed in the savannah areas at the end of the rainy season and that the birds move from one rich food area to another as the supplies are exhausted. Alternatively, factors other than density-dependent mortality through food shortage may control the absolute and relative numbers of birds present (i.e. see Wynne Edwards 1959, Ripley 1959a). If this were so and the numbers maintained at such a level that food supplies were never limiting, clearly competition would not occur. In the Ganges Valley ' superabundance ' of food is most likely at the start of the dry period but it seems improbable that this should outlast the season. Competition, it seems, must occur at some times and in some localities in every year, but its extent and duration remains an open problem. One method of study would be to weigh samples of natural populations throughout the dry season.

c. Mate Selection

As all the weavers breed in the monsoon real possibilities of cross breeding exist in nature. Only in two cases are there differences in breeding season between sympatric species. In the Kumaon *P. megarhynchus* breeds earlier than *P. manyar*, *P. benghalensis* and *P. philippinus* though there is some overlap in timing. Similarly in Java Spennemann (1926) states that while *P. philippinus* starts breeding in early February *P. manyar* does not begin until middle or late March. As these two species are so similar in their habitat preferences in Java this contrast is likely to have considerable significance in preventing hybridisation.

Factors reducing the chances of interspecies mating in these weavers are contrasts in : (i) coloration, in particular the nuptial dress of the male, (ii) the sequence of events in courtship, (iii) the postures of advertisement and courtship display, their orientation and accompanying vocalisation, (iv) nest site, (v) nest form and fabric, and (vi) habitat. The relative importance of these factors is undetermined, but present observations suggest that i-iv are of particular significance with other factors playing a contributory role. Mate selection, which is performed by the female, is probably a response to the summation of the effects of numerous mutually reinforcing stimuli from the male, his nest, and the context of the whole behaviour. If any factors have negative valence they will play the part of ' inhibitors ' (Marshall 1959) the summation of which may prevent breeding.

i. *Coloration.* The coloration of male weavers is species-specific and minor contrasts also exist between the females. In parti-

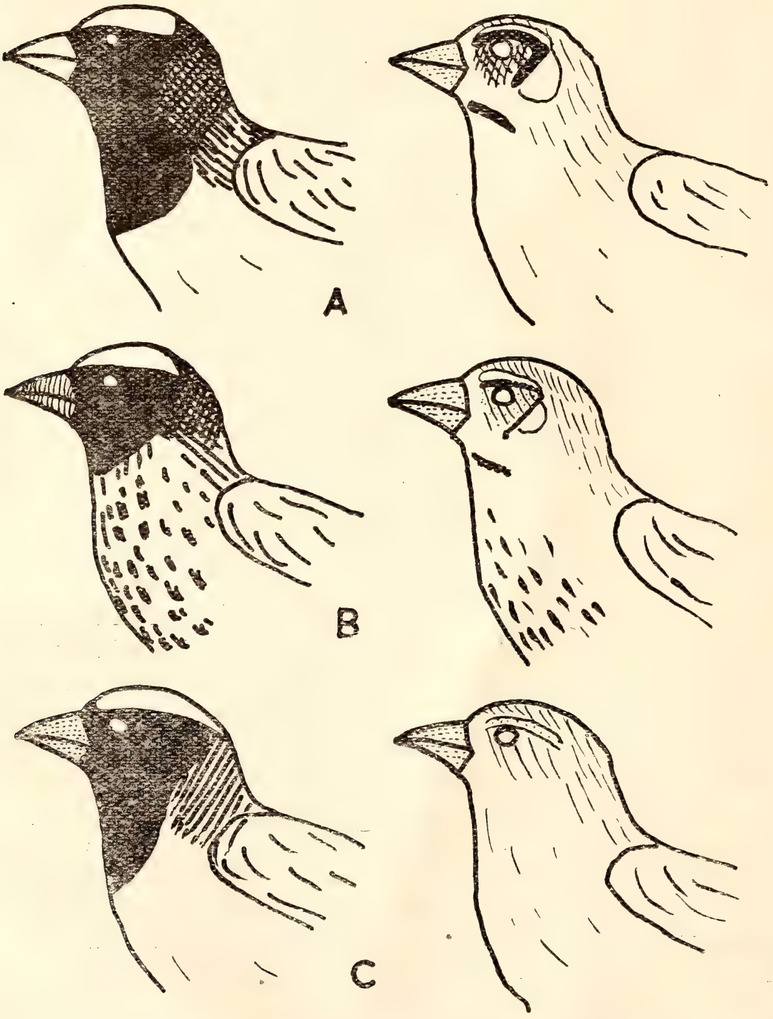


Fig. 5. Heads of male and female weavers. A. *Ploceus benghalensis.* B. *Ploceus manyar.* C. *Ploceus philippinus.*

EXPLANATION TO FIGURE 5

MALES	A. *P. benghalensis*	B. *P. manyar*	C. *P. philippinus*
Beak	Blue	Black	Dark brown horn
Crown	Orange-yellow	Golden yellow	Golden yellow
Face	Black with dark brown nape	Black with brown striated nape	Black with brown nape
Breast	Black	Striated	Upper black ; lower yellow
Underparts	White	Striated ; white on belly	Yellow ; white on belly

NOTE : In the field male *P. manyar* often showed striated nape running up as a cleft for a short distance into yellow of crown. Yellow ends in straight line in *benghalensis*.

FEMALES	A. *P. benghalensis*	B. *P. manyar*	C. *P. philippinus*
Beak	All females have beak of horn brown colour.		
Superciliary stripe	Yellow above thick black line	Pale yellow above thin dark brown line	Pale fawn
Cheeks	Grey	Fawn	Dark fawn
Ear coverts	Large yellow patch behind black line	Small pale yellow patch behind brown line	Dark fawn ; no yellow
Chin	Yellowish white	White	White
Moustachial streak	Black	Dark brown	None
Breast	Pale fawn	Striated	Pale fawn

All the characters listed are those observed through × 8 binoculars in the field and found useful for identification of females in the colonies.

cular the yellow heads and bodies, including the rump, of both *P. megarhynchus* and *P. hypoxanthus* males set these species apart from the others. *P. philippinus*, *P. benghalensis*, and *P. manyar* are alike in colour patterning, the main contrasts being the black chest in *P. benghalensis*, streaked in *P. manyar*, and yellow in *P. philippinus*. Further, while the bills of breeding male *P. philippinus* and *P. manyar* are dark brown-black, those of *P. benghalensis* are pale blue (see details—Fig. 5).

ii. *Sequence of events in reproductive behaviour.* Here again the behaviour of *P. megarhynchus* contrasts sharply with the other Indian species ; in particular courtship is restricted to the territory and no sexual chasing occurs (Ali & Crook 1959). Nothing is known of the courtship of *P. hypoxanthus.*

In general the events and postures in the reproductive behaviour of *P. philippinus, P. manyar,* and *P. benghalensis* are remarkably alike. There are however important contrasts in the sequence in which these events occur and in the precise context in which the Wing Beating Displays are given. This contrast in context also involves a shift in the function of the display. In Table III the sequences of events for the three species are summarised. Thus in *P. philippinus* the timing of events goes : (a) Nest Advertisement (i.e. invitation) and acceptance ; (b) Courtship in the territory with sex chasing outside it ; (c) Mating in the territory. In *P. manyar* it is : (a) Advertisement Display in the territory ; (b) Sex chasing and courtship, the latter both within and without the territory ; (c) Nest invitation by pseudo-female solicitation by the male, and mating. In *P. benghalensis* : (a) Courtship approaches to female with WBD and sex chasing ; (b) Flight to the nest, female following and entering with male WBD outside ; (c) Nest acceptance and mating. Thus whereas in *P. philippinus* and *P. manyar* advertisement precedes courtship, in *P. benghalensis* courtship comes first and nest visiting second. In all three species, however, unlike *P. megarhynchus,* sex chasing is an important element in courtship.

iii. *The postures of Advertisement and Courtship and contrasts in motivation.* The main contrasts here are :

(*a*) The WBDs of *P. philippinus* are usually inverted below the nest while those of *P. manyar* are upright and given in the territory usually *near* the nest rather than *upon* it. The WBD of *P. benghalensis* is given without reference to the nest and is exclusively oriented to the female. Thus, while the displays of the first two species have advertisement function in attracting females to nest and territory, that of *P. benghalensis* is essentially a courtship posture. The extreme similarity of these displays indicates their homology.

The compositions of the ritualised WBDs are remarkably alike. The wing beating speeds differ but little (Table I) and tail elevation varies only in the greater frequency of depression in *P. philippinus.* There are, however, differences in wing arc, the elevation of *P. manyar* and *P. benghalensis* being greater than that of *P. philippinus.* Again while the beaks of *P. benghalensis* and *P. philippinus* are normally turned down during display (Fig. 1) that of *P. manyar* (Fig. 3) is not. *P. benghalensis* gives a short soft song during display while *P. manyar* gives a curtailed song phrase, and *P. philippinus* a special cry (Crook 1960c). All these contrasts probably originated through differential sexual selection of displays in isolated populations, but the tail and beak differences originally probably expressed motivational contrasts in courtship prior to posture ritualisa-

TABLE III

SEQUENCES OF EVENTS IN THE REPRODUCTIVE BEHAVIOUR OF *PLOCEUS PHILIPPINUS*, *P. MANYAR*, AND *P. BENGHALENSIS*

Ploceus philippinus	*Ploceus manyar*	*Ploceus benghalensis*
I. Females approach established colonies.	I. Females approach established colonies.	I. Females approach established colonies.
II. Males give inverted WBD in Advertisement on nest with a special cry. Social facilitation between males occurs.	II. Males give UWBD on rushes etc. in their territories as an Advertisement Display. Social facilitation sometimes occurs.	II. Males approach females often outside the territory and give UWBD with depressed beak and song. This is the initial courtship posture. No social facilitation between males.
III. Females enter nests.	III. Female enters territory and may go to the nest. Finally flees with male in a sex-chase.	III. Female follows male to territory and either goes to nest or flies away again. Sex-chases follow.
IV. Male gives a WR posture and bows with a song into the nest. If female flees nest he pursues her in sex-chase, if she stays in territory courtship occurs.	IV. Female follows returning male to territory. Male performs pseudo-female solicitation in the nest entrance.	IV. Female follows male to territory and goes to the nest. Male displays UWBD or often UWRD outside nest entrance.
V. Mutual adjustments, male chases female aggressively from territory many times. Sex-chases lead to renewed courtship.	V. Female enters nest and male at once attempts copulation. Female may flee but commonly accepts.	V. Mutual adjustments. Female commonly attacks the male as he approaches her in display. Sex-chase often repeated.
VI. Female solicits in nest ring. Copulation.	VI. Copulations in nest entrance etc.	VI. Copulation in nest entrance etc.

tion. Thus tail depression, otherwise common in threat, suggests that prior to ritualisation the tendency to attack was strong during the relevant phase of *P. philippinus* courtship. Similarly beak depression suggests a tendency to escape in conflict with attack (Crook in press, in preparation). Such contrasts are supported by an analysis of the motivation of contemporary unritualised posturings in the courtship of the three species.

(*b*) The ' pseudo-female solicitation ' posture occurs in *P. philippinus* (Crook 1960c) and in *P. manyar* but not in *P. benghalensis*. In *P. manyar* it is most marked and plays a special role in enticing the female to the nest and in initiating copulatory behaviour (Fig. 4).

Contrasts in behaviour sequences and postures express differences in motivation. Analysis is based on the methods of Tinbergen 1959, Hinde 1953, 1955, 1956, Morris 1956, Andrew 1961 and follows analyses of other Ploceinae (Crook 1962 etc.) in which the rationale is given in detail. In brief, the reproductive behaviour of the weavers is determined by the interaction of attack, escape, and sexual responses in conflict. The relative strengths of these tendencies in courtship vary between related species and produce contrasting behaviour patterns. In addition the strength of attachment to nest during courtship varies between the species. The number of sequences containing attack (and threat) is particularly high in *P. philippinus*, high in *P. benghalensis*, but low in *P. manyar* (see Table IV). In correlation with this a particularly high percentage of sequences ends in copulatory behaviour in *P. manyar* while *P. philippinus* and *P. benghalensis* show low percentages. In the latter species this is probably due to the fact that 18/23 recorded sequences containing aggression involved attacks by females on approaching males. The giving of aggressive responses in a sequence clearly reduces greatly the chance of a copulation in that visit, aggression inhibiting sexual behaviour. By contrast in *P. manyar* the high rate of copulatory activity correlates with a high frequency of male behaviour patterns expressing sex and escape tendencies in conflict (the ' pseudo-female postures ' see Morris 1952, Hinde 1955, 1956, Crook 1960b).

These comparisons suggest : (i) The threshold for attack on females entering a territory is low throughout the early courtship of *P. philippinus* and is only gradually raised as the sexual tendency increases in strength during courtship. The tendency to remain at the nest is strong until the female has actually entered the structure after which chases occur. (ii) In *P. benghalensis* the male has a low threshold for sexual behaviour and the tendency to remain at the nest is weak. Thus on the approach of a female he flies out and approaches her. The nearer he gets the stronger becomes his tendency to escape. The female at first responds to these approaches, often within her individual distance, with attack. Only after many sequences does her threshold for attack rise as she begins to respond sexually to the male's approaches. (iii) The male *P. manyar*, shows particularly strong tendencies to behave sexually and to flee from the approaching female. This is associated with relatively strong nest attachment and a high threshold for attack.

It follows that while aggressiveness inhibits the early expression of sexual behaviour in the sequences of *P. philippinus* and *P. benghalensis*, in the former case this is due to the male's tendency to attack approaching females near his nest, and in the latter to the female's aggressive response to the approach of courting males. In *P. manyar* courtship attempts by the male are frequently frustrated by the female's lack of responsiveness rather than by aggression by either sex.

To summarise : the displays and postures of the three species are homologous. The WBD clearly plays an important role in mate selection, and females probably react specifically to the posture composition (and coloration) and also to the display orientation. The major contrasts concern orientation—whether the display is given to the female away from or at the nest, and whether it is upright or inverted. Such contrasts undoubtedly enhance the likelihood of reproductive isolation, particularly since they are maintained when two species are breeding in mixed colonies (*P. manyar* and *P. benghalensis*) in the same habitat. Both the contrasts in behaviour sequences and in postures depend largely on differences in motivation between the species.

TABLE IV

COMPARISON BETWEEN THE BEHAVIOUR SEQUENCES OF THREE ASIAN WEAVERS DURING PAIR FORMATION

Species	No. of sequences containing attack or threat upon sex partner	No. of sequences ending in copulation or attempted copulation	Other sequences ending inconclusively in the departure of the female	Total of sequences
Ploceus manyar (Diagrams B and C)	13 (28.8%)	21 (46.7%)	11 (24.4%)	45
Ploceus benghalensis (Diagram A)	23 (32.3%)	8 (11.2%)	40 (56.4%)	71
Ploceus philippinus (Schemes B and C in Crook 1960c)	31 (65.9%)	13 (27.6%)	3 (6.5%)	47

NOTES: (*a*) In *P. benghalensis* 18/23 aggressive sequences were initiated by the females as against 7/31 in *P. philippinus* and zero incidence of female attack on males in *P. manyar*. Other attack sequences were initiated by territorial males. Discussion in text.

(*b*) Statistics: An overall X^2 test gives the significance of the differences between the proportions for the three species at the 0.001 level and similar tests, taking the species in pairs, give in each case significance at the same level. Real behaviour differences are thus considered established.

iv. *Nest site.* It is uncertain how far differences in nest site as such are of direct significance to the female. For instance in Kumaon *P. philippinus* females visit *P. manyar* colonies in reeds and hop about actually visiting their nests in the absence of the males. It seems probable also that female *P. manyar* and *P. benghalensis*, not easy to distinguish quickly in the field, may also visit each other's untenanted nests particularly in mixed colonies. No *P. manyar* or *P. benghalensis* females have been recorded in the tree sites of *P. philippinus*, however, and although *P. megarhynchus* often build nests (in Kumaon) in rushes they have not visited structures of *P. manyar* when perching in their colonies.

v. *Nest form and fabric.* The fact that female weavers spend much time examining and adjusting the fabric of the nests they visit suggests that differences in nest form and the manner of construction might inhibit acceptance of a nest not built by a male of the species. The globular structures of *P. megarhynchus* and *P. hypoxanthus* are of course quite different from those of the other species, and where *P. hypoxanthus* and *P. manyar* are sympatric this may be a factor preventing female interest in each other's colonies or nests. Nests of *P. benghalensis* and *P. philippinus* are particularly alike both in form and in the fineness of the materials used although mud is plastered more extensively in the interiors of some *P. benghalensis* nests than has ever been recorded for *P. philippinus*. *P. manyar* nests are rough, rather ' angular ' balls made of coarser materials and have a shorter tube (in Kumaon), and mud is often plastered fairly extensively in the egg chamber. Nonetheless female *P. philippinus* visiting *P. manyar* colonies not only enter the nests but mandibulate the fabric extensively suggesting little appreciation of these differences. Spennemann (1926) considered nest construction important in pairing and showed that male *P. manyar* destroy nests not accepted by a courted female and build another in the same or a near-by site. Sálim Ali (1931) has also recorded the destruction of unaccepted nests by the male *P. philippinus*.

vi. *Breeding habitat.* Specific preferences for certain habitats undoubtedly play a major role in ensuring reproductive isolation. Where, however, the preferred habitats are dovetailed in an intricate fashion as in the Kumaon area, direct segregation of the species is very much reduced and the factor of less significance.

Observed attempts at cross-mating

So far no direct evidence for hybridisation between any Asian weaver species in the wild has been obtained, and in captivity there are only two records of possible hybrids between *P. manyar* and *P. philippinus* (Gray 1958). There are, however, some observations showing that male

P. benghalensis do occasionally chase and mount female *P. manyar* in mixed colonies. In a particular case recorded by Sâlim Ali (in litt.) the female was already mated and in possession of a nest of its own species.

Such cases are probably due to the relative inability of males to distinguish quickly their own mates and females of their own species. Since, however, it is the female which ultimately chooses her mate and nest, and which therefore plays the fundamental role in mate selection (as in the American Grackles, Selander & Giller 1961), it follows that only observations showing females to have chosen mates and nest of a species other than their own can be considered evidence for hybridisation of any biological significance. No such cases have yet been recorded.

d. Conclusions

The above discussion allows the following conclusions regarding the extent of competition and the maintenance of reproductive isolation between sympatric Asian weavers.

Competition

(*a*) *Ploceus megarhynchus* probably has quite different food preferences from those of the smaller species in Kumaon. In SE. Asia *P. hypoxanthus*, probably also takes different food from the three smaller weavers.

(*b*) *P. philippinus*, *P. manyar*, and *P. benghalensis* probably take similar or identical foods and must compete for nourishment in environments where they are sympatric if food supplies are limiting. Differences in habitat preference in the breeding season and food ‘ superabundance ’ for at least part of the dry season probably reduce the extent of competition considerably. Exact measures are required. In Java contrasts in breeding season and altitudinal range between *P. philippinus* and *P. manyar*, the nest siting of which is identical there, have been noted.

Reproductive isolation

(*a*) Differences between the species in six sets of variables influence to varying extents the likelihood of matings between the closely related species. Matings between *P. philippinus*, *P. manyar*, and *P. benghalensis* are possible, especially between the last two in north India and the first two in Java where ecological similarities are particularly apparent. In the latter case, however, contrasts particularly in the timing of the breeding season reduce the likelihood of hybridisation.

(*b*) Of the variables discussed, contrasts in the coloration of the males, in the sequences of events in courtship, in posture composition, and in song are likely to play a direct role in inhibiting cross-matings. Contrasts in the behavioural context, orientation, and form of the ritualised

Wing Beating Displays are probably especially significant as the latter function as signals in the initial communication between the sexes at the onset of pairing. The contrasts in orientation are particularly important and are closely linked with the differences in nest site. Differences in the conflict motivation shown by each species in the behaviour sequences are apparent, and might involve incompatibilities in any attempted hybridisation in addition to the effects described above.

(*c*) The close contiguity of breeding colonies of *P. manyar* and *P. benghalensis* allows males to attempt copulations with females of species other than their own. Females have, however, never been seen choosing mates and nests of another species.

These results suggest that some degree of competition may exist in India particularly between *P. manyar* and *P. benghalensis* and in Java between *P. manyar* and *P. philippinus* although in both cases this must occur only for limited periods and only in the few localities where extensive sympatry occurs. Inter-breeding between the species is prevented by a number of species-specific characters.

IV. THE EVOLUTION OF THE ASIAN WEAVERS

a. The African origin of the Asian weavers

The weavers (Ploceinae) are found throughout Africa and tropical Asia but not in the desert areas of the Sahara and the Middle-East. Most of the 95 species occur in Africa and only 5 are known in Asia. In Africa all biomes have weaver representatives : rain forest, montane forest, humid and dry savannah, lakeside, and grass. The Asian species, however, are restricted to savannah, grassland, and swampy country.

In spite of the absence of a fossil record a coherent evolutionary picture of a bird family can be built up from two sorts of evidence: firstly, a precise knowledge of comparative anatomy and behaviour together with an understanding of the functional significance of these characteristics in relation to species ecology, and, secondly, a knowledge of the ecological changes dependent upon climate, which have occurred within the geographical range of the group during the relevant period of time. While at present this latter type of evidence is meagre there is sufficient to construct an hypothesis which represents in outline the likely course of events. The picture will become clearer not only through further study of the birds themselves but through an improved understanding of the phytogeographical changes in Asia since the Pliocene.

The following points suggest that the ancestors of the Asian weavers invaded Asia from Africa at a time, or at times, when a suitable tract of country connected the two continents.

(*a*) Prior to the Miocene unbroken evergreen forest is believed to have stretched from West Africa to eastern tropical Asia. As the weavers are not represented in the Asian forests they could not have been part of the widespread pan-Afro-Asian avifauna of that time. They must have invaded African evergreen forests after the biome had split.

(*b*) The great majority of weaver species occur in Africa which has been the main centre of radiation of the group.

(*c*) The weavers appear to have originated as savannah species and to have entered forest secondarily (Chapin 1923, Crook in preparation). Their spread northwards and eastwards into Asia was dependent upon the existence of a suitable tract of open country in those areas.

(*d*) The Asian weavers are few, all are open country birds of general similarity to African savannah species but showing signs of long isolation and parallel evolution. Typical African grassland weavers (i.e. *Euplectes* spp., *Quelea* spp., etc.) and insectivorous weavers (i.e. *Malimbus* spp., *Ploceus bicolor*, etc.) are not represented in Asia suggesting that only the most adapatable seed eating species of the genus *Ploceus* reached a latitude sufficiently northerly to turn the Arabian Gulf and spread into Asia.

The suggestion that Asian weavers came from a stock of savannah adaptation is supported by their nest structure. The tubed nests (retort shape B, Crook 1960a, and in preparation) of *P. philippinus*, *P. manyar*, and *P. benghalensis* are characteristic of weaver construction in trees when fine terminal twigs are used for suspension. In Africa such nests occur in both forest and savannah. In swamp, grass, or scrub, however, African weavers have globular nests supported from below rather than above. Now, in spite of major contrasts in nest site, *P. manyar* and *P. benghalensis* retain the same basic tubed nest as *P. philippinus*, and all are suspended from their upper parts. This indicates that the Asian grassland and swamp species are derived secondarily from a tree-nesting stock, to which *P. philippinus* is presumably very similar, and that in the absence of selection to the contrary they have retained the tubular entrance to the suspended nest. Only in *P. manyar* is there a noticeable shortening of the tube. Since there are no forest weavers in Asia the tree-dwelling ancestors must have lived in savannah.

The nests of *P. megarhynchus* and *P. hypoxanthus* are globular but, while that of the latter is only sited in bushes in swamps (etc.), the former places its nest both in a curious tree-top site (Ali & Crook 1959) and in reeds. This major contrast with the *P. philippinus* species group, taken together with other anomalous characteristics, suggests that *P. megarhynchus* and *P. hypoxanthus* come from a separate stock. The nest construction and siting suggest that these birds built globular nests in dense scrub or marsh in the manner of *Quelea quelea* (Morel, Morel & Bourliere 1957) in Africa today. Once in Asia, they became specialised to their particular sites and ways of life in different areas.

(*e*) As no Asian weaver lives in particularly arid areas, except where watercourses, wells, and agriculture provide tolerable conditions for *P. philippinus*, it can be assumed now that their ancestors belonged to the relatively humid African savannah contribution to the Indian avifauna rather than to the Somali-Arid element (Chapin 1923, Hussain 1958, cf. Ripley 1959a).

Only two Asian weavers are widespread over the whole area (*P. philippinus* and *P. manyar*), and only *P. philippinus* can be considered a very common bird. *P. benghalensis*, *P. megarhynchus* and *P. hypoxanthus* all have small ranges and those of the latter two species are much subdivided. This suggests that, while the weavers spread widely in Asia on their arrival and underwent adaptive radiation, obscuring any close relationship with African forms, later phyto-geographical changes brought about restrictions in range for all except the two species able to take active advantage of them (*P. philippinus* and *P. manyar*). Thus, while *P. benghalensis*, *P. megarhynchus*, and *P. hypoxanthus* are essentially relict populations, *P. manyar* and especially *P. philippinus* are dynamic and expanding stocks (see Darlington 1957).

Although a general similarity between the African and Asian weaver faunas persists, certain details of weaver life in Asia are peculiar to that area. These features are : (i) the development of colonial life in areas of short rainy seasons without reduction of courtship activity outside the territory (*P. megarhynchus* excepted) ; (ii) the development in *P. philippinus* of elaborate nest repair behaviour ; (iii) the use of mud in nest construction (*P. hypoxanthus* ?). These points refer particularly to *P. philippinus*, *P. manyar*, and *P. benghalensis* and are probably all correlated closely in relation to the survival value of the particular type of nest constructed by them. *P. philippinus* resembles closely many colonial species of relatively dry areas in Africa, but unlike them does not show reduction in the amount of sex chasing beyond the limits of the territory. In African species such as *P. cucullatus* the survival value of this limitation is held to be that it reduces the frequency of nest robbing attacks by neighbouring males by increasing the amount of time spent in active occupation of the territory. Nest robbing is known to delay nest completion appreciably and, in a short breeding season, this reduces the chances of a male acquiring a maximum number of females for his nests and of having young in them during the period of optimum food availability. Furthermore, females will only accept properly completed nest baskets with at least a fine floor to the egg chamber. In *philippinus*, by contrast, the male is often absent from his nest and sex chasing and nest robbing then occurs without hindrance. Any damage done is, however, repaired with a speed and agility not seen so far in tests on African species. In addition the male brings several strands of material to the nest on each visit and the method of construction is such that it encourages rapid repair and constant fabric maintenance. Female *P. philippinus* accept nests in the ‘ Helmet stage ’ when the floor of the egg chamber is not yet finished. The males await acceptance before completing the structure. Furthermore, *P. philippinus* maintains the nest by constant attention throughout its occupation. These features of construction, together with the use of mud, appear originally to have been adaptations to rain-shedding, thereby keeping the young from chilling. Additionally they permit rapid nest repair thereby eliminating the necessity of a courtship restricted to the nest area (Crook in press). *P. benghalensis* and *P. manyar* have not yet been tested for their repair abilities. Some observations suggest that the constant padding of the fabric, typical of *P. philippinus*, is absent. The nest sites in thick vegetation with a reduced visibility between nests may entail a reduced frequency of nest robbing compared with the tree site and hence less need for repair. Furthermore, the nests may be better protected from rain. In conclusion the contrasts between *P. philippinus* and similar African species are interpreted as different adaptations to identical selection pressures occasioned by high seasonal rainfall and nest robbing by other males.

b. Dispersal and adaptive radiation

The dispersal of weavers through Asia depended upon the provision of suitable climatic and vegetational conditions. It is therefore essential to determine, so far as possible, the nature of the phyto-geographical changes that occurred within the relevant time period. Recent studies suggest that the age of the Oscines is very much less than had previously been suspected—their radiation probably occurring primarily in the Miocene (Darlington 1957). Furthermore, while Brodkorb (1960) puts the average longevity of pleistocene birds at about ½ million years and the top longevity at one million, Moreau (in press) points out that the fossil evidence is mostly non-passerine. He considers that for passerines the figures are likely to be very much lower even for the oldest species. This suggests that, at most, the present Asian weavers could only have seen two glaciations and have undergone their radiation entirely within the Pleistocene.

Moreau (in press) has recently completed a re-evaluation of the ecological history of Africa since the Pliocene based upon new geological evidence obtained since his earlier account (1952). During the Pleistocene three glacial periods occurred of which the last continued for at least 50,000 years prior to 18,000 years ago. During this period the temperature of Africa must have been some 5°C. lower than at present at the glacial maximum, and a corresponding reduction in evaporation would have increased the effectiveness of the rainfall. The reduction in temperature would have extended the area of the montane biome down to between 500 and 1000 metres greatly restricting the lowland biota except in the areas to the west of the Cameroons. The montane avifauna, at present restricted to small isolated areas, would have ranged from the Cameroon Highlands to Abyssinia and to South Africa. Such extension in range must have occurred at each glaciation to be followed by recession and local isolation. In addition sub-regional geological changes, the dating and relationship of which to the glacial changes are not yet understood, occurred. The most significant to the present discussion are the extensions of the Sahael (Sudanese climatic belt) to at least 300 miles north of the present position (on the last occasion only about 7000 years ago) and the southward movement of the palaearctic fauna at least 400 miles into the Sahara.

Changes similar to these must have occurred in both the Arabian and the Indian areas. It seems likely that during each glaciation unbroken palaearctic conditions must have reached southward deeply into Arabia and Persia, in the latter, due to the elevation of the land, penetrating to the coastal strip. In India the whole of the elevated Deccan Plateau was much cooler and more humid and, except where edaphic factors were unsuitable, a Himalayan type of flora and fauna similar to those at present restricted to the Nilgiri Hills, parts of the Western Ghats, the hills of Assam, and the Himalayan foothills (Ali 1949) must have been widespread throughout. Following the glacial maxima the montane biota would have receded giving place to tropical forest in the wetter areas and savannah in the drier or poorer soils (i.e. in Rajasthan and the Deccan traps). At this time a savannah vegetation probably linked Africa through Arabia to India along a rather narrow coastal strip of Persia. The Indo-Gangetic plain was covered by flat land of high water table and presumably flooded for long periods each year. Such seasonal flooding prevents the establishment of a climax swamp forest and great areas of marsh and wet grassland, similar to the uncultivated tarai of today, probably existed.

Archaeological evidence from the Harappa culture (3250-2750 B.C.) and records in stone and literature from Buddhist and ancient Hindu sources (around 2000 years ago) allow a limited reconstruction of the flora (Randhawa 1945, Law 1954). The forests stretched from west to east along the Satpura-Vindhya range (furthest west at Aravalli Hills) and south to the Ajanta area (Hora 1949, Ali 1949, Ripley 1949, 1959a, Dilger 1952) while some probably persisted for a long time in the Indus basin. The forests of the Western Ghats, north central India, and Burma thus formed an unbroken area bordering swamps and grassland in the wet Ganges Valley and savannah in both Rajasthan and to the south in the area of the Deccan traps. Within these forests there must have been sub-divisions into the flora of the cooler more elevated regions, then diminishing in extent, and those of the lower altitudes. Other contrasts due to the differential distribution of the monsoon rainfall over the area must also have occurred.

The above picture represents a stage in the progressive desiccation which has been going on since the last Ice Age (d' Aubreville 1949, Moreau 1952, Ripley 1959a). The forests of central India have now disappeared and only groves remain (Randhawa 1949). Much of the Ganges Valley is very arid in the dry season.

Similar changes must have occurred in SE. Asia with a major expansion southward of cool climate biota over higher ground at the glacial maxima followed by a recovery of vast tropical forests. In southern Burma, Thailand, and south Indochina the climax forest development was probably prevented over wide areas by prolonged seasonal floods resulting in a grass vegetation (Suvatabandhu 1958, Stamp 1959). During the Ice Ages the islands of Borneo, Java, and Sumatra were connected together with Malaya and Indochina to form the vast continental area of Sundaland. Changes in that land area have been extremely complex (Umbgrove 1949, Beaufort 1951, Dammerman 1929) but most of it must have been covered by rain forest (Richards 1952). In the huge river system draining north over the low-lying land between Malaya and Borneo there were probably patches of open grass-scrub and palms and occasional extensive areas of swamp or grassland maintained on a heavily waterlogged soil. Such areas are more likely than swamp forest because when Sundaland was undivided the climate in the rain shadow to the north of the Sumatra-Javan mountains was probably very much drier than at present with a seasonal rainy period. It follows that, as on the Amazon, the upper reaches of the great northward flowing river contained much swamp grassland rather than the forest that is all to be seen today. Following the Ice Ages the low-lying areas between the present islands were gradually submerged.

The dispersion of the weavers was probably affected by these changes in the following way :

(i) The main eastward movements of the birds probably correlated with the recessions of the last two Ice Ages. During glaciation movement must have been prevented by the southward penetration of the palaearctic biota into Arabia and Persia as well as the expansion of the ' montane ' floras of Africa and Asia. The ensuing savannah conditions in the Middle East must have been ideal for dispersal of seed-eating weavers. During the arid interglacial period, however, desert regions must have constituted a barrier as at present.

(ii) Entry to India would have been much hindered by forest barriers. As these broke up under increasing desiccation the eastward movements, particularly into the Deccan, continued.

(iii) Since only the last two glaciations are considered, it follows that the weavers could have reached Asia following either the last or the penultimate Ice Age. The Red Sea and Persian Gulf do not appear to have constituted effective barriers. The relict distributions and characteristics (such as the nest form) of *P. megarhynchus* and *P. hypoxanthus* set these species apart from the other Asian birds. They probably represent a distinct and phylogenetically primitive group within the genus, which entered India at the earlier glaciation to be followed later by the more advanced birds of *P. philippinus* type when conditions again became suitable for movement.

Both *P. megarhynchus* and *P. hypoxanthus* are marshland birds and the savannah ancestor is no longer extant. The size contrast is unlikely to be completely explained as an example of Bergmann's Law although *P. megarhynchus* undoubtedly lives in the cooler climate, at least in winter. The upright stance in display and the nest form of *P. megarhynchus* suggest that the use of the tree-top nesting sites is recent following the reduction of swampy marshland.

(iv) The ancestors of *P. philippinus*, *P. manyar*, and *P. benghalensis* presumably spread first into savannah country around the Indus Valley and in Rajasthan. Forest belts doubtless still existed in the Indus basin together with large swamps along the river. The opportunity thus existed for a population to colonise the marshland. A similar region in the Ganges Valley was more certainly cut off from savannah by forests in the Delhi area and to the south. Once weavers had reached the area adaptation to the prevailing marshland would have followed rapidly. Thus at an early date opportunities existed for the development of two marshland populations in the eastern and western limbs of the Indo-Gangetic plain. The relatively greater contrast between *P. benghalensis* and *P. philippinus*, together with the restricted range of the former, suggests that *P. benghalensis* was the first to diverge, probably in the Indus basin. The *P. manyar* stock from the Ganges Valley could have spread eastwards later to colonize the highly suitable marshland areas in SE. Asia by moving along the coasts. It also proved more adaptable than *P. benghalensis* and spread widely over India and Ceylon wherever suitable marshy areas existed.

There are of course several possible alternative explanations. *P. manyar* may have arisen in SE. Asia from a stock ancestral both to it and *P. benghalensis*, or it may represent a second invasion of the Ganges swamp-land at a later date from *P. benghalensis*, when the two had diverged sufficiently for reproductive isolation to have developed. Be this as it may, the main point here is that the local conditions in north India and parts of SE. Asia, in which large swampy basins lay surrounded by forests and at periods effectively isolated from savannah on higher, drier, or poorer land, provided the local isolation during which marshland populations could diverge from the parental savannah stock.

The savannah birds persisted in suitable areas as the ancestors of

P. philippinus. Furthermore, as drier conditions developed and savannah spread, the birds ranged widely over India especially in the Deccan.

(v) Prior to the dissolution of Sundaland SE. Asia appears to have contained widely dispersed populations of both *P. hypoxanthus* and *P. manyar.* Later the flooding of the low-lying land between Sumatra, Java, and Borneo seems to have entailed the virtual extinction of most of the weaver populations that lived there. The vast unbroken forests of Malaya, Sumatra, and Borneo would not support a relict population but on drier Java, with its Monsoon climate, a small population of *P. manyar* survived (presumably at first only on the northern alluvial plain), and eventually adapted to the absence of extensive swamps by moving in on a tree nesting site. *P. hypoxanthus* also survived locally on Sumatra and Java.

(vi) The spread of the adaptable and vigorous *P. philippinus* through the forests of SE. Asia seems to be a recent event occasioned by the felling of forests and the opening up of areas to agriculture. It is found now irregularly throughout Malaya (which has no other weavers), Sumatra, and Java, but has not yet reached Borneo where the almost unbroken forests would probably effectively prevent colonisation. In Java *P. manyar* and *P. philippinus* probably compete (see above) ; the result seems to be the present contrast in altitudinal range and breeding season.

In spite of obvious weaknesses and the paucity of information the above argument does account in general for the facts available and explains the origin of the extant Asian weaver species. During isolation the populations diverged sufficiently in habitat preferences and in reproductive behaviour, so that now that the forest barriers have largely disappeared sympatry occurs without extensive hybridisation. The specific ranking of the birds is certainly justified even though the precise extent of their ecological and behavioural interaction remains to be determined. The degree of competition that occurs is an expression of the continuing unstable relations between the species and their environment.

c. The origin and nature of the behavioural differences

The differences between the Asian weavers concern primarily the coloration of the males, habitat preferences, nest sites, and the methods of communication between the sexes by display and voice during pair formation. In particular, contrasts in the orientation of the WBDs and their context within the courtship sequences have been shown to correlate with different motivation in the species concerned. All these contrasting features are fundamentally directed to the guiding of the female to the nest. It is thus the nest site and the nature of the environment around it which comprise the ultimate factors determining the behaviour shown.

In the tarai contrasts in nest site and communication behaviour are maintained in sympatry in an area of complex interdigitation of species habitats, and it appears that they are genetically controlled and hence innate. However, nest site selection is by no means invariably fixed[1] and, in particular, the contrasts in site between *P. manyar* races on Java and elsewhere suggest that here the factors determining site selection may be sufficiently labile to allow the choice of trees in one locality and rushes in another. The convergence of *P. manyar* in nest site, and probably in courtship, to *P. philippinus* on Java may thus depend on the relative absence of swamp there and the choice of tree sites for nests. Here then the whole shift from the characteristic marshland behaviour of the species could have been due to a direct reaction to the environment. Whether at present the site selection of the Javan population is environmentally or genetically controlled will require much further analysis but the point raises wide issues.

' Genetical systems do not directly and rigidly determine the characteristics of organisms but set up reaction ranges within which those characters develop ' (Simpson 1953). Within the labile reaction range the particular character depends upon interaction with the environment. It thus seems probable that the initial adaptation to the grass nest site in a recently invaded (or rapidly changing) environment was due to the differential survival of those members of a population whose site preferences were sufficiently labile to allow the choice of a site, abnormal for the species, but of adaptive significance. Such ' facultative adaptations ' dependent upon particular environmental circumstances may be distinguished from ' fixed innate adaptations ' determined genetically independently of the environment (Underwood 1954). Furthermore, the learning of the species nest site by the young occupants (i.e. nest site imprinting) may result in the perpetuation of the preference in succeeding generations and the establishment of a tradition (Thorpe 1945, Klopfer 1961). The establishment of such a tradition may allow the selection of genetic changes such that eventually the site preference becomes incorporated into the genotype (i.e. the ' Baldwin effect ', Thorpe 1945, Mayr

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[1] Note the variation of nest sites chosen by *P. philippinus* in different parts of its range : tall palmyra and date palms near Bombay, vegetation over or hanging within wells near Poona and in the Deccan, trees on canal and stream banks in the tarai, and bungalow verandahs in eastern India and Burma. Even within a given area different sites are chosen in different localities (Crook 1960c, Table I) but the species has never been recorded nesting in rushes or reeds. Similarly occasional records (Hume 1890) describe *P. manyar* and *P. benghalensis* nesting in atypical sites such as low bushes over water rather than in reeds and grass but never in palms or tall trees. In addition Ali (in litt.) informs me that *P. megarhynchus* breeds both in tree-tops and in reed-beds in the same area of the tarai. In this case the preferences cannot be controlled by genetic contrasts as the populations must intermingle in feeding flocks and probably visit both types of site when selecting building places.

1947, Waddington 1953, Simpson 1953, Hinde 1959, Underwood 1954), the behaviour thus becoming ' innate '. This, however, is not essential for the perpetuation of the behavioural change once the tradition is established.

The contrasts in nest site between these three weavers correlate with major differences in the conditions of cover affecting the visibility of the Advertisement displays attracting females to the nest. Thus if a male with a nest hidden in grass continued to display upon it not only would the likelihood of a female seeing him be reduced but the male, often unable to spot the approach of females, might be inhibited frequently from display.

In such a context however the likelihood of neighbouring males seeing one another frequently on their nests is less and the tendency to visit neighbouring nests to steal materials is probably reduced. A reduced frequency of observation of his fellow males is likely to lower the aggressiveness of a territory owner so that the threshold for attack behaviour would rise. This would correlate with a reduced tendency to stay constantly beside the nest and a lowered threshold for approach to females. Displays would thus soon become orientated towards approaching females away from the nest rather than upon or very close to the structure. This could be a simple phenotypic effect of reduced visibility and less territorial trespassing. Furthermore, since the male's display is rarely released without the sight (or sound) of other males in display, and since the performance of display is probably rewarding, particularly if it ends in sex chasing and especially in copulation, the birds may learn to give their displays on grass tops etc. rather than upon the nest, so that a tradition may develop through some such process as ' local enhancement '. Certainly the *P. philippinus* data (Crook 1960c) showing that males sometimes leave their nests on the approach of a female and display upright on twigs indicate that the display orientation is sufficiently labile to allow the development of a facultative adaptation here. Further shifts in orientation so that the display comes to be given following an approach flight to the female could develop in the same way.

This approach could account for the present differences in pair formation behaviour between *P. philippinus*, *P. manyar*, and *P. benghalensis*. *P. philippinus*, a highly successful dry country stock responding fully to the climate changes favourable to it in the present epoch, retains the original inverted nest-oriented type of advertisement at the tree nest-site. In *P. manyar*, nesting in rushes and reed-beds scattered over swamps, the relatively loose character of the vegetation appears to have permitted the retention of display near the nest so that it still functions as a territorial proclamation. The dense grass in which *P. benghalensis* places its nest makes approach to the female a necessity if initial contact between the sexes is to be established. The display here becomes purely of courtship function and in correlation with this the song is much subdued. Furthermore the motivational contrasts between the three species in the tarai (pp. 26-29) are also explained.

In Java the local race of *P. manyar* places its nests in trees with good visibility all around. As a result the behaviour of the bird probably resembles that of *P. philippinus* extremely closely.

The important question then is to determine the limits of lability of nest site selection in each species for it is this that very largely determines the types of pair formation behaviour (Crook 1962). Thus, while *P. philippinus* chooses a wide range of sites in different localities, the conditions of visibility around the nests remain about the same and the communication system between the sexes in reproductive behaviour is not affected as it would be if a local population suddenly took to the reeds. In the case of the Java population of *P. manyar* the change does involve a major increase in visibility which probably has affected the signal system. Here then the lability of site selection appears to have been larger than for *P. philippinus* and has probably had more severe consequences. In the Kumaon tarai, in spite of the mixture of habitats, each species shows clear nest-site preferences suggesting that the range is fairly tightly controlled. There is, however, probably sufficient lability to allow quite a drastic change of site should the birds be confined to a habitat radically different to the preferred one. The effect of such a change, which might be arranged experimentally, on the orientation of the WBD would be extremely interesting to observe.

Finally, while the stereotyped appearance of the ritualised displays (Tinbergen 1952, Blest 1961, Crook 1962) in advertisement must be the result of sexual selection, differences in the posture material, upon which selection has worked in producing the signal, may well have been determined initially by shifts in the strengths of tendencies to remain at the nest and to approach the female of the type described above.

Thus while characters such as plumage coloration, body size, beak proportions, nest structure, and ritualised wing beating displays have narrow reaction ranges, other characteristics such as nest-site selection, the orientation of the displays, and the sequence of events in courtship are probably more labile and, through their adaptability, allow rapid phenotypic adaptation to invaded or changing environments. It follows that some ' fixed adaptations ', such as the ritualised displays, may be dependent for their orientation and function on facultative adaptations perhaps maintained by local or specific traditions.

d. Species grouping

Moreau (1960) placed the Asian Ploceines in two separate species groups of the genus *Ploceus*, the first consisting of *P. manyar*, *P. philippinus*, *P. benghalensis*, and *P. megarhynchus* and the second of *P. hypoxan-*

thus together with the African species *Ploceus* (*Pachyphantes*) *superciliosus*. This latter group was established mainly upon supposed similarities in nest structure, which a close reading of the literature taken in conjunction with new observations in Africa on the nest form and construction of *P. superciliosus* (Crook in preparation) now show to be invalid. Since Moreau's account the new data on *P. megarhynchus* has also become available. In the above survey it is shown that while *P. philippinus*, *P. manyar*, and *P. benghalensis* are extremely similar to one another, *P. megarhynchus* and *P. hypoxanthus* resemble one another much more than either resembles the *manyar* group. It is thus considered that the two species groups of the genus *Ploceus* found in Asia be composed as follows : (1) *Ploceus megarhynchus* and *P. hypoxanthus*, (2) *Ploceus manyar*, *P. philippinus*, and *P. benghalensis*. Neither appears to have any close relationship with any well-studied African species group.

V. SUMMARY

(i) In many areas of tropical Asia several closely related Ploceine species show sympatric distributions. The problems of reproductive isolation and competition posed by these species are discussed. New field data on *Ploceus benghalensis* and *Ploceus manyar* observed in the Kumaon tarai 1959 are provided, and the characteristics of these and other Asian weavers are summarised in Tables II and III.

(ii) The available data suggest :

(*a*) *Ploceus megarhynchus* and *P. hypoxanthus*, which differ greatly in body size, bill proportions, coloration, nest form and site, and behaviour (still unknown for *hypoxanthus*) from other Asian weavers, are only distantly related to them and would under no circumstances in the wild interbreed or compete with them.

(*b*) *P. philippinus*, *P. manyar*, and *P. benghalensis*, probably take similar or identical foods and compete for nourishment in areas of sympatry under conditions of food shortage. Differences between the species in habitat preferences in the breeding season and ' superabundance ' of food in at least part of the dry season probably limits the frequency and duration of periods of competition. Actual measures are required.

(*c*) The six contrasting variables likely to play a role in ensuring reproductive isolation between *P. philippinus*, *P. manyar*, and *P. benghalensis* are: (i) coloration of nuptial males, (ii) sequence of events in courtship, (iii) postures, orientation and vocalisation during Wing Beating Display, (iv) nest site, (v) nest form and fabric, and (vi) habitat. The first four are the more important—in particular the orientation of WB display postures, which is closely correlated with differences in nest sites. The females perform mate selection so that attempts by males in mixed colonies to mount females other than those of their own species are not, by themselves, of much biological significance. Deliberate female choice of male, nest, and site of a species other than her own has yet to be recorded.

(iii) The ancestors of the Asian weavers entered Asia from Africa as savannah-adapted birds. Radiation into swamp and grassland species has occurred in isolation within Asia. Evidence from nest structures and sites, comparative behaviour, and, in particular, the few available studies of vegetation changes in Asia since the Pliocene, is used to produce a hypothesis for the radiation and speciation of the birds. The relative importance of ' innate ' and ' traditional ' behaviour in the maintenance of specific characters is briefly discussed.

The Asian weavers are listed in two groups : (a) *Ploceus megarhynchus* and *P. hypoxanthus* ; (b) *P. philippinus*, *P. manyar*, and *P. benghalensis*. Neither appears to have any particularly close relationship with any existing African species group of the genus.

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APPENDIX

STATISTICAL ANALYSIS OF BILL MEASUREMENTS ON SAMPLES OF PLOCEINE MATERIAL FROM THE BRITISH MUSEUM

The table below gives the mean beak lengths and beak depths (from top to bottom of bill at its base when closed) for male ($\bar{x}$) and females ($\bar{y}$) of each of the four species : (A) *Ploceus manyar* (n♂=12, n♀=6), (B) *P. benghalensis* (n♂=2, n ♀=10), (C) *P. philippinus* (n♂=11, n♀=6), and (D) *P. hypoxanthus* (n♂=5, n♀=4). Also it shows the sums and differences $\bar{x}+\bar{y}$ and $\bar{x}-\bar{y}$ together with their estimated standard errors. Tabulating $\bar{x}+\bar{y}$ rather than of $\frac{1}{2}(\bar{x}+\bar{y})$ makes only one standard error necessary for each species since s.e. $(\bar{x}-\bar{y})$=s.e. $(\bar{x}+\bar{y})$. These estimated standard errors are calculated on the assumption that the variance of beak length or depth is the same for all the eight groups, so that a fairly precise estimate of this can be obtained by pooling the estimates for the separate groups. The differences between the estimates for the separate groups are in reasonable agreement with this assumption, which enables one to include all the groups in the analysis and not just those that are fairly well represented (thus B ♂ has not been omitted).

	Beak length					Beak width				
Species	$\bar{x}$(♂)	$\bar{y}$(♀)	$\bar{x}-\bar{y}$	$\bar{x}+\bar{y}$	S.e. of $\bar{x}-\bar{y}$, $\bar{x}+\bar{y}$	$\bar{x}$	$\bar{y}$	$\bar{x}-\bar{y}$	$\bar{x}+\bar{y}$	S.e. of $\bar{x}-\bar{y}$, $\bar{x}+\bar{y}$
A	1.690	1.667	0.023	3.357	0.027	1.201	1.188	0.013	2.389	0.026
B	1.685	1.642	0.043	3.327	0.043	1.255	1.145	0.110	2.400	0.040
C	1.727	1.690	0.037	3.417	0.028	1.188	1.215	0.027	2.403	0.026
D	1.562	1.495	0.067	3.057	0.037	1.304	1.270	0.034	2.574	0.035

(*a*) Beak lengths

Although none of the differences $\bar{x}-\bar{y}$ exceeds twice its estimated standard error, they all have the same sign, which suggests a systematic sex effect. If there were no sex effect each difference would have the same chance of being positive or negative, and the probability that all 4 differences have the same sign is only $\frac{1}{8}$. In fact the average difference $\frac{1}{4}(0.023+0.043+0.037+0.067)=0.0425$ is significant at the 5% level (its estimated standard error is only 0.0172).

Moreover the 4 values of $\bar{x}-\bar{y}$ do not differ significantly from one another at the 5% level, so that the data may be considered consistent with the hypothesis that the sex effect is the same for all 4 species. On this hypothesis the best estimate of the sex effect, obtained by taking a weighted mean of the 4 values (the weight being proportional to the estimated variances of $\bar{x}-\bar{y}$) is 0.0388 (with standard error 0.0161). However, it is perhaps doubtful whether this hypothesis is meaningful as D is clearly different from A, B, C (if D is omitted, the weight mean becomes 0.0323, which is not significantly different from zero at the 5% level, being only about 1.8 times its estimated standard error 0.0178).

The values of $\bar{x}+\bar{y}$ for A, B, C do not differ significantly at the 5% level (this is almost obvious from the magnitudes of the estimated standard errors), while the difference between $\bar{x}+\bar{y}$ for D and these are very highly significant.

(*b*) Beak widths

The situation here is less clear. For the values of $\bar{x}+\bar{y}$ we reach the same conclusion as in (*a*), those for A, B, C not differing significantly at the 5% level and the difference between them and $\bar{x}+\bar{y}$ for D being very highly significant. But the behaviour of the values of $\bar{x}-\bar{y}$ is rather puzzling. The differences between them are quite large compared with their standard errors and, if we test the hypothesis that the sex effect is the same for all 4 species, we obtain a result that is just significant at the 5% level. In view of this, averaging the 4 values is not very appropriate. Omitting D does not alter the result, which is due to the value of $\bar{x}-\bar{y}$ for B being much greater than the rest ; in fact B is the only species for which $\bar{x}-\bar{y}$ is quite highly significant. (B ♂ has only two members, but that does not affect the argument, as the small size of this group is properly allowed for in the formula for the standard error. Certainly it might not be legitimate to treat the 2 members as a random sample from the species but this is an objection that may be applied to any of the groups regardless of their size).

N.B.—I am indebted to Mr. A. M. Walker of the Statistics Laboratory, Cambridge, for this analysis and discussion.

Chapters on the History of Botany in India

VI. THE PUBLICATION OF HOOKER'S *FLORA OF BRITISH INDIA* AND WHAT ITS PUBLICATION RELEASED

BY

I. H. BURKILL

[*Continued from Vol.* **59** (3) : 777]

1. THE PUBLICATION OF HOOKER'S *FLORA OF BRITISH INDIA* RELEASES *FLORAS* OF DIVISIONAL OR SUB-SUB-AREAS

Sir **Joseph Hooker** described his FLORA OF BRITISH INDIA as ' an attempt to sweep together and systematise a century of hitherto undigested materials scattered through a library of botanical books and monographs, in vast public and private herbaria and a "pioneer work" '. It was a large undertaking ; its seven volumes together weigh so much that a botanist cannot conveniently take them into the field ; the work is for the study. In a valedictory preface to the last volume he expressed a wish that ' it would facilitate the preparation of local floras'. That it did. By the time that others were in a position to guess the date of its conclusion some of them were engaged on writing their own local Flora. So much the better. Hooker himself set the example by taking up at once the completion of Trimen's HANDBOOK TO THE FLORA OF CEYLON ; and he had vol. 4 out in 1898 and vol. 5 in 1900. But the reader is entitled to comment—5 is not a great reduction on 7. The next author in time was Theodore Cooke with the first part of his FLORA OF THE BOMBAY PRESIDENCY who reduced the number of volumes to 2, albeit bulky. **Theodore Cooke** (1836-1910) had gone to India in 1860 to build railways ; Botany became a hobby, ability brought him to the position of Principal of the Poona Civil Engineering College and it was from it that he organized both teaching and a field study of Botany. When the Forest Service wanted to start training Forest Rangers (see chapter V, section 11) he came forward with proposals to have Botany taught at Poona. The proposal was not accepted. But when King advised the formation of the Botanical Survey (see chapter V, section 12) Cooke organized (1891) a Bombay section complete with a Presidency Director and collectors and within the College buildings a herbarium which remained under his direction until he retired (1893).

From 1866 **George Marshall Woodrow** (1846-1911) had been in charge of the Ganeshkhind Experimental Garden—in 1872 his charge was extended over all the official gardens in Poona ; in 1879 he became lecturer in the College ; and in 1893 when Cooke retired the directorship of the local Botanical Survey passed to him. He held it until 1899, when his retirement came and it was passed to **George Gammie**. The Survey originated a method of collecting by caravan. This team was well calculated to advance available knowledge of the Bombay flora. Cooke determined to write a Flora for which purpose he moved to Kew on retirement. He had divided a personal herbarium into two parts, one to retain, the other for the Herbarium in the College. Cooke contrived to get a volume of his FLORA completed by 1901. Later, when an unfortunate fire destroyed the Herbarium that he had so enriched, he gave in replacement the half that he had kept. He continued his work, completing it by a second volume (1908).

It will conduce to clarity if I assemble the dates here: Ceylon, recognizing that the first essential rested in a Flora, began the preparation of that for the island with Trimen's appointment to the post of Director of the Peradeniya Garden (1879) ; Bengal held itself ready at the publication of Hooker's FLORA OF BRITISH INDIA (1897) and was prompt (1903) with one ; Upper India held itself entitled to begin one (1903) ; Bombay and Madras were left behind ; Bombay took the help that Kew was able to offer and Cooke did his work there ; the means of Bombay had not been developed adequately. Later Madras needed similar help. As the Government of India had turned a nearly deaf ear to King's suggestions for linking the botanical work of the different parts of India together, the efforts were independent, save that the Saharanpur and Calcutta gardens kept in rather close touch.

When Cooke commenced making his collections he was so domiciled as to be able to explore rather more freely that part of the Presidency where Bombay City and Poona are than the southern parts of the Presidency ; these were then getting the attention of **Alexander Talbot** and **A. P. Young.** The considerable collections of the latter were sent to the British Museum (Natural History) in 1884.

The next Flora to reach printing was **Kanji Lal's** FOREST FLORA OF THE SCHOOL CIRCLE, i.e. of Dehra Dun. It was out as a whole in 1901, the year of Cooke's first volume and much before Cooke's second. It was followed in the next year by two other Floras, Sir **David Prain's** BENGAL PLANTS and Sir **Henry Collett's** FLORA SIMLENSIS; and these were followed one year later by the first part of **Duthie's** FLORA OF THE UPPER GANGETIC PLAIN AND THE ADJACENT SIWALIK AND SUB-HIMALAYAN TRACTS. With this sequence of dates before him my reader sees how real was the release.

Beyond all doubt, each of the five authors felt the need of keeping down the size of his volume or volumes ; but they reacted in very different ways. Prain took the most original line. Writing actually for the students that he taught in the Medical College and well aware that the common garden plants of Bengal were on the whole better known to them than the country's wild plants, he inserted these, getting room to do so by excluding descriptions in favour of keys. Brandis, who had retired to his native town in Germany at some date in the early nineties, returned to taxonomic work ; and, restricting himself as he had done before to woody plants, started to write his INDIAN TREES. In 1899 he moved to Kew that the work might be checked there. The book has great value, but is of course not a geographic section cut out of the FLORA OF BRITISH INDIA. It was not published until 1906. Another forest Flora which must have been well in preparation before 1900, but not published until 1909 (with a second in 1911) was Talbot's FOREST FLORA OF THE BOMBAY PRESIDENCY AND SIND.

Duthie's FLORA is deserving of great praise, but progressed so slowly that he himself did not complete it.

Prain, while engaged on writing his BENGAL PLANTS prepared a working list for the use of the dweller in Calcutta—a list of the plants of the three districts that surround the city—Howrah, Hughli, and the Twenty-four Parganas. It was printed in the third volume of the *Records of the Botanical Survey*. The nearer these publications were to the date of the FLORA OF BRITISH INDIA the more faithfully do they follow its taxonomy. Does my reader at times give thought to the ' species ' as a conception that has grown up very much without challenge but with universal consent ? That consent is basic in the biological sciences, and the species concept is unavoidable. But the individual taxonomist, except, it seems, a Russian school, forms his own concept of the range of variation which he should allow. That being so, it was vastly to the advantage of India that one man, namely Sir Joseph Hooker, should be allowed to impress his estimate of specific range on the whole phanerogamic flora of the subcontinent.

To a small extent Dalgado's FLORA OF GOA escapes Hooker's influence in that **Celasio Dalgado**, the author, though a correspondent, was not more closely associated with Kew. He had been born in Goa, had qualified in Medicine, and became the Civil Surgeon of the little State of Sawantwadi. Goa and Sawantwadi are outside the area of Malabar whence Rheede drew his information ; but it was the HORTUS MALABARICUS that drew Dalgado to his study of the simples. The FLORA was published in 1898 ; and later its author lived in Lisbon.

While Prain was at work on his Flora, the surgeon John Justus Wood of the Madras Medical Service retiring, moved to Chota Nagpur and collected compiling a list of the PLANTS OF CHUTIA NAGPUR published in the *Records of the Botanical Survey* in 1902, and two missionaries Father **Cardon** and the Rev. **Campbell** of Pokhuria collected. Further the

Hieronymite missionary, Father **Rastier**, collected at Bettiah in the unworked district of Champaran.

The following information may be inserted here. A list of Simla plants was printed privately by Mr. **H. B. Smith** and Lady **E. Smith** ; and some years after 1900 Miss **Emilia Frances Noel** published an enumeration of plants that she had found in various parts of Kashmir.

Right in the extreme south of India **Emile Deschamps** and **Francis Wilms** collected. The first mostly in the French Settlements of either coast and in Ceylon ; the second in Kerala. Wilms's specimens were given to Kew.

2. COOPER'S HILL AND A MORE FAVOURABLE OUTLOOK IN INDIA TOWARDS BOTANY

Towards the end of section 11 of chapter V the reader was made aware how it came about that teaching was provided at Dehra Dun for Forest Rangers and told that, though Brandis was still in India when events led up to it, the moving spirit was Schlich's.

Schlich was Inspector-General of Forests for less than five years, as in 1885 he left for Britain to organize another teaching centre—the Forestry College as part of the Imperial Engineering College at Cooper's Hill (some 20 miles west of London) where Foresters for India were to have the advantage of learning their technology through the medium of their own tongue and under a specially appointed staff.

I have called the Botanists who entered the Forest Service under Brandis, Brandis's front line. Those who followed them, and had had a different training make the second line. They had for a teacher Marshall Ward who was appointed to the Professorship of Botany (1886).

Harry Marshall Ward (1854-1906) was contemplating a career as a teacher of the Natural Sciences when at the age of 20 he attended evening classes taught by the most inspiring teachers in London, and then went to Cambridge where he passed botanically under Vines. With a degree gained, he was chosen to go to Ceylon with an appointment of two years in which he was to find if possible a way of suppressing the coffee-leaf disease. That experience over he taught Botany in the University of Manchester until chosen for Cooper's Hill.

His suitability for the post was undoubted, his experience of tropical vegetation a recommendation, and he taught for 10 years. I put before my readers the names of a few of his pupils who made their mark on the Botany of India with the dates of entering India : **H. H. Haines** (1888), **C. G. Rogers** (1888), **R. L. Heinig** (1895), **C. E. C. Fischer** (1895), and **R. S. Hole** (1896). Marshall Ward left Cooper's Hill in that year, before the following two new pupils could finish their courses : **B. B. Osmaston** (1896) and **R. S. Troup** (1897).

Cooper's Hill is near enough to Kew, for Ward to bring over his students week by week in summer to see live plants falling within their interest.

The reader perhaps comments that the botanical maturity of these officers came one or two decades after 1900 at which my chapter is expected to end. That is so. I break bounds as without looking forward the shaping of the end of my period will become uninformative and ragged as regards Troup's most valuable work.

Henry Haselfoot Haines (1867-1943) reached India at the very end of the year 1888. He had passed out of Cooper's Hill at the head of the list and it was to be his to serve in northern Bengal forests which Schlich himself had organized excellently ; he was in these forests until 1899 when he was moved to Singbhum, south of the Ganges, where working plans for forest management were in hand. Haines collected, but had not at first the idea of writing on that flora. The idea came in a further spell of service in the same part of India which enlarged his opportunities. It may be said that he was fortunate in regard to them. He escaped the very great transfers which have broken into the experiences of so many of the botanists of the Forest Service—interruptions through wide experiences are pleasant if time is given for digesting them. He became Divisional Forest Officer for Chota Nagpur and when he could obtain leave tramped through four of the districts of Chota Nagpur to extend his knowledge. Being appointed to the new post of Imperial Forest Botanist at Dehra Dun (1905) he had the time and the means of working out his collections. The working out was finished next at Kew. On his return to India his results to date were embodied in his FOREST FLORA OF CHOTA NAGPUR INCLUDING GANGPUR AND THE SONTAL PERGUNNAHS (1910).

Chota Nagpur had of course come within the area that Prain covered in his BENGAL PLANTS, but that in no way lessened the value of Haines's FLORA, for Haines wrote for an entirely different assembly of readers, and moreover his descriptions were original. We do not need to follow Haines's successive appointments ; it suffices to record that in 1914 he became Conservator of Forests, Bihar and Orissa, and that the gradual extension of the interest of the Forest Service over forests in which grazing was encouraged had meanwhile increased the responsibilities and directed attention to the carpet of herbs on the soil. Now at last a complete flora had the right which Haines gave to it. Haines had collected as he could ; then again he used his own time to work the plants out in the Calcutta Garden and at Kew.

How far Haines's opportunities were officially designed to lead to a complete FLORA can only be ascertained from official records. One would like to think that they were ; whether it was so or was not, the curating and naming cost Haines most of his leisure. He gave the collections to Kew when his book had appeared.

The next name on the list is that of **Charles Gilbert Rogers** (1864-1937). Like Haines he had his early service in northern Bengal ; thereafter he was posted to widely scattered parts—the Andaman Islands, Berar, and Pegu, so scattered that the learning of each flora involved a step back at each transfer. This and a catholicity in interests made him a collector for others ; but he did much to promote their work.

The third name on the list is that of **Robert Lawrence Heinig.** He had service in the Andaman Islands, Chittagong, and the Sundarbans. He compiled A FOREST MANUAL OF THE ANDAMANS which was published in 1900 ; and he collected a large part of the information required for working plans for the forests of the Sundarbans whence Calcutta so extensively gets its fire-wood. He compiled A LIST OF PLANTS OF THE CHITTAGONG COLLECTORATE AND HILL TRACTS (1925) and supplied to Prain much information for his FLORA OF THE SUNDRIBANS (*Rec. Bot. Survey Ind.*, 1903).

The fourth name on the list is that of **Cecil Ernest Claude Fischer** (1874-1950). He had had part of his technical training at Nancy and part at Cooper's Hill. Arriving in India in 1895, he was sent to Madras and did the whole of his service in that Presidency except a short spell of teaching at Dehra Dun. He sent collections to the Calcutta Garden and, when stationed at Coimbatore from 1911 forward, was able to give time to the flora of the Anamalai Hills and with the help of collections in the possession of the Agricultural College to produce his 'Survey of the Flora of the Annamalai Hills' (*Rec. Bot. Survey Ind.* **9**, No. 1; 1921). After retirement he became Assistant for India in the Kew Herbarium (1925-1937) and did most valuable work including the completion of Gamble's unfinished FLORA OF MADRAS.

Robert Selby Hole (1874-1938) arrived in India in 1896. He had passed out of Cooper's Hill at the head of the list. His first service in India was in the Central Provinces ; then he was sent to Dehra Dun as Instructor in the College; following this he was promoted Imperial Forest Botanist in succession to Haines (1906), teaching and investigating forest composition and chiefly the make-up of the ground covering, seeking the relation between it and the canopy. Hole was indeed a pioneer. In 1909 he was instructed to prepare a text book for the student. This, his MANUAL OF BOTANY FOR INDIAN FOREST STUDENTS, has for us the great interest of exposing what was taught.

Bertram Beresford Osmaston was an earlier Instructor in the College, then did service in various parts of northern India, and was again on the College staff, sending collections to the Calcutta Garden.

The last name on this list is that of **Robert Scott Troup** (1874-1939). He reached India in 1897, already a marked man ; and was sent to the Tharrawadi teak forests of Burma, whence 9 years later he was called to the establishment at Dehra Dun; and at Dehra Dun he completed his service in India in 1920, returning to Britain to succeed Schlich at Oxford as Professor of Forestry.

Troup comments in one place that the Service in India had not the ability—one may say had not the experience—for drawing up working plans until after the days of Brandis. Genuine plans came later and were gradually improved as experience was gathered. Then came the concentration of the minds who did the actual planning at Dehra Dun, and after that the establishment of a Research unit—the Research Institute with five divisions, one of them for working plans. Troup being at Dehra Dun, when the Institute actually came into being, was at first given the Division of Utilisation, but was soon turned over to the Division of Working Plans. The transfer gave him charge of a vast store of data on tree behaviour which he digested into his masterly SILVICULTURE OF INDIAN TREES.

In the year after Troup, **Sir Ralph Pearson** went out to India in the Forest Service. It suffices to add his name as being that of one of the men who put Botany forward. He was not of Marshall Ward's teaching.

I have sought in this section to convey to the reader how greatly Schlich's educational policy was calculated to increase the efficiency of the botanically minded who reached India, and that the needs of the Service were segregating specialists and, again, what the delegation of work to Dehra Dun has meant.

At the same time a voice whispers—Dehra Dun is far from central.

3 VASCULAR CRYPTOGAMS OVER THE HALF CENTURY

No one can complain that ferns do not get the attention of botanists. Because they are of a size similar to herbaceous flowering plants, they get the same attention. They even get rather more, for there are many of those who specialize. The mosses get the attention of collectors of mosses.

This section is a continuation of the record brought to 1850 on p. 84 of the second chapter. Soon after that year two botanists whose interests were wide, cleared a way for the fern specialist ; they were **R. H. Beddome** and **C. B. Clarke.** Beddome published in 1863-1864 his FERNS OF SOUTHERN INDIA : BEING DESCRIPTIONS AND PLATES OF THE FERNS OF THE MADRAS PRESIDENCY, following it in 1865-1870 by his FERNS OF BRITISH INDIA : BEING FIGURES AND DESCRIPTIONS OF FERNS FROM ALL PARTS OF BRITISH INDIA. Later (1883) came his HANDBOOK OF THE FERNS OF BRITISH INDIA, CEYLON AND THE MALAY PENINSULA.

C. B. Clarke had slightly anticipated the last by publishing in 1880 his paper—'A Review of the Ferns of Northern India' (1880). **Henry Francis Blandford** followed in 1888 with his FERNS OF SIMLA.

Very striking indeed is the relative abundance of ferns in different parts of India, so striking as to set the mind wondering on what limiting factor Nature failed to evolve ferns more freely for generally unsuitable areas. The local poverty is illustrated by what Prain records in his BENGAL PLANTS. His area is divided by him into 10 sub-areas: Tirhut, Bihar, Chota Nagpur, North Bengal, Central Bengal, West Bengal, Orissa, East Bengal, Tippera, and Chittagong. He names 112 species, of which 88 are found in Chittagong, 53 being only in Chittagong. Chittagong therefore for a collector of ferns is a paradise. After Chittagong Chota Nagpur is favourable, for it has 12 that are unrecorded for other sub-areas of Bengal and 5 more in common with Chittagong, but not beyond these two sub-areas. The rest of Bengal is strikingly poor, so poor as to handicap the Botanical teaching in Calcutta by making material for illustration difficult to get, save from the Botanic Garden ; and of the Garden it may be recalled Griffith discovered his fern material deficient (see p. 66 of the second chapter).

It is evident that the fern specialist who is not free to travel may be area-limited.

Of fern-lovers connected with India Sir **William Norris** may have been among the first ; if not, it would be because he was not collecting during his earlier years in Ceylon : he collected vigorously after his transfer to Penang as Recorder for the Straits Settlements. Lady Dalhousie was at the time in Penang and an enthusiastic companion in the field. Sir William Norris went back to Ceylon as Chief Justice (1847), and on retirement took his collections to Britain and they were given to Kew. He has already been mentioned in chapter II as climbing Mount Ophir with Griffith.

Ceylon is a paradise for the botanist seeking ferns. **William Ferguson** (1820-1887), a Surveyor who reached the island in 1839 and was there until his death, collected ferns during part of his long career, and in 1880 published an account of them. There were three other collectors in the island about that time—**George Wall,** a merchant of Colombo, W.**Thomas Naylor Beckett,** a coffee-planter, and **Frederick J. Hutchinson,** an army officer. They rivalled each other in collecting and helped each other. Hutchinson collected also in the Nilgiri Hills. After his service in the East he was stationed in Plymouth and, when he died, he left a beautifully mounted and cared-for collection. A contemporary, collecting in northern India, was **Charles William Webley Hope** (1832-1904), a Civil Engineer who had reached India in 1859 and had adopted fern collecting as a pastime. His FERNS OF NORTH-WESTERN INDIA was published by the Bombay Natural History Society in 1899-1903. One of Hope's interests was to connect the epiphytic ferns with the most favourable support, a line of study which belongs to ecology. **Harry Corbyn Levinge** (1831-1896), of the Bengal Public Works Department, collected ferns in the

Sikkim and Kashmir Himalaya and in the Nilgiri Hills ; and **J. Munro,** a tea-planter, collected in Sikkim. It happened that Britain was leading Europe in attention to ferns ; and, by British workers of the time in India, the knowledge of the ferns was brought to a very dependable level.

Not so the Mosses; specialists interested in them were few, and their study more difficult.

The study of the Mosses of India may be said to have commenced when the road to Nepal was opened ; but it was not long before the southern parts of the Peninsula also received attention. **Francis Buchanan,** the first (1802) to collect in Nepal these small but most attractive plants, had collected mosses to good effect in Scotland before he went to India (see Prain, LIFE OF FRANCIS BUCHANAN p. vi footnote). The first close attention to the southern mosses came from some of the earliest to settle in the Nilgiri Hills and also when collecting in Ceylon followed. Sir Joseph Hooker, when he searched for geographic data for his SKETCH OF THE FLORA OF BRITISH INDIA, was compelled to admit that in 1900 data which would serve him did not exist. Nor did they for yet another 30 years—that is until the publication of a list compiled by Professor **J. P. Brühl** (*Rec. Bot. Survey Ind.* **13**, pp. 15-120 ; 1931). The list suggests a great abundance among them in all the wettest parts of India proper, not only of species of mosses but also of endemics. This great endemism is doubtless exaggerated and will be reduced by further study as exploration is continued. Many of the Ceylon species not recorded as occurring in the mountains of southern India will be found to have been overlooked ; and a considerable number now known from the Nilgiri or Palni Hills will be found in the Western Ghats or elsewhere outside their known range. As for the species of Burma the knowledge that we have is very meagre.

Among the collectors of mosses in India, the only taxonomist so advanced as to make determinations had been **Griffith.**

In my second chapter I referred to Mitten's CONSPECTUS of the mosses that he knew to occur, and I got together the names of the collectors to his year of publishing (1869). At that date Thwaites was collecting as opportunities came to him, and Mitten (1873) reported on Thwaites's specimens including what W. T. Naylor Beckett obtained for Thwaites. In 1872 **Odoardo Beccari** left Italy on his great travels in Malaysia, and halted in Ceylon for a short time. His mosses, then collected, were determined later by Hampe (1872). Activity increased towards the end of the century. J. F. Duthie collected vigorously when touring in the north-western Himalaya, and Brotherus reported on the results. He reported also on mosses collected in Coorg by Dr. **T. L. Walker.** Mrs. **May Bradford** collected in the Sikkim Himalaya ; **J. H. Darrell** and C. E. C. Fischer in southern India, H. N. Dixon reporting on these.

A. W. Fraser, an officer in the Royal Engineers, collected in northern Burma.

The Hepaticae drew very little attention until 1893, in which year **Victor Felix Schiffner,** at the time a lecturer in Prague, was commissioned to write up this group for Engler's PFLANZENFAMILIEN, and to get material travelled in Bombay, Ceylon, and forward to Malaysia, collecting in large quantities.

4. THE MICROSCOPE IS GREATLY IMPROVED AND BOTANY PROFITS IN UNDERSTANDING THE LOWER PLANTS : EFFECTIVE COLLECTING OF THEM BEGINS IN CEYLON

The great improvements referred to in this section were made in Europe, where every branch of Botany profited, perhaps most of all the understanding of sex in the higher plants, which, as it involved understanding sex in the plants at large, intensified the interest in the Algae and Fungi. The first Botanist to make any systematic attempt at collecting these in our area was **George Gardner** who in 1844 reached Ceylon as Superintendent of the Peradeniya Botanic Garden. During the short time before his death in 1848 he sent herbarium specimens to his former teacher, Sir William Hooker, and by the services of the artist Harmanis De Alwis preserved records of fleshy Agarics in coloured drawings. But Gardner's time was short ; and it was not much that he could do.

William Henry Harvey (1811-1860) as a school boy made all the use that he could of holidays at the sea-side to satisfy a tremendous inquisitiveness into the life that was there, and again as a young man in business used the opportunities of holidays. Among diverse interests he found his greatest in collecting the sea-weeds of the British Isles. Then came to him some years of employment at the Cape of Good Hope where he made acquaintance with a different algal flora. A return to Ireland was followed by appointment as Keeper of the Herbarium of the Dublin University. He had made a friendship with Sir William Hooker as far back as 1829 ; now University vacations allowed Harvey personal contact with him in work at Kew. Publication on British sea-weeds commenced. Harvey was next enabled to visit the east coast of North America. In 1853 he executed the largest collecting trip of his life. He sailed for Egypt, proceeded via Aden to Ceylon, then went to Singapore, Australia, the Central Pacific, the west coast of South America, and returned to Dublin carrying back very extensive material ; and in Dublin was elected a Professor (1848). His collection had numbered 5000 specimens before Australia was reached.

The reader realises how advantageous it was that so great an authority should name up the Ceylon sea-weeds.

Next as to Fungi :

Thwaites, as the reader will have realized, was at Peradeniya at the time of Harvey's visit. He had been in Ceylon for 2½ years, finding his feet, enquiring what the obscure as well as the obvious plants were. Like Harvey he had been in business and his knowledge was that which a naturalist gets by contact with living things.

He was soon sending specimens which he could not name to Sir William Hooker at Kew and leaving to his discretion the manner of handling them. Hooker from 1828 had had the friendship and co-operation in work of the mycologist, M. J. Berkeley, and all the fungi received from Thwaites were sent to Berkeley.

Miles Joseph Berkeley (1803-1889) was already a naturalist before he went as a student to Cambridge. There he came into the company of J. S. Henslow, not as yet the Professor of Botany but sufficient of a leader to have been elected Secretary of the Cambridge Philosophical Society.

Berkeley left Cambridge for a curacy at Margate on the Kent coast, where he was able to give his leisure to studying the life of the sea-shore, just as Harvey was doing on an Irish coast of very different aspect. Berkeley's first publications were on animals ; the next (1833) were on Algae. Fungi later usurped the first place, partly because Berkeley by moving inland lost touch with the sea-weeds and partly because he found his energy satisfied when Hooker persuaded him to undertake the elaboration of the Fungi for his edition of Smith & Sowerby's BRITISH FLORA. Later the interest became world wide and a very fruitful association commenced between Berkeley and **Christopher Edmund Broome** (1812-1886) which carried the study of Ceylon fungi so far that before Broome's death they had described more than 1200 species. Broome was by profession a lawyer, but leisured and had had the friendship of Thwaites in Bristol.

The coffee-leaf disease, *Hemileia vastatrix*, got its condemnatory name from them in 1871 ; but it had not deserved the epithet *vastatrix* had not intense cultivation, by offering unbroken stretches of planted coffee, invited its riotous spread.

Wallich's son **George Charles Wallich,** born in the Calcutta Garden in 1818, after taking the degree of doctor of medicine in Edinburgh had entered the service of the East India Company. In Calcutta he became a specialist in the Diatoms of Lower Bengal and of the Bay of Bengal and listed them. Later when the great undertaking came of connecting the coasts of Britain and North America by a submarine cable (1860) he was drawn from India to study the life on the floor of the Atlantic.

The algae of the Indian fresh waters, swamps, rice fields, and rivers got little attention ; and it was their smallness that led to this.

In 1888 an ingenious botanist, Professor **G. von Lagerheim,** observing in the Copenhagen Museum much debris attached to the roots of a specimen of a *Myriophyllum* collected by Hooker in the Bengal plains, soaked off the adherent material, and identified 52 species of algae in it. Then he treated specimens of *Utricularia* similarly.

Professor **George Dickie** (1813-1882), at one time of Aberdeen and then of Belfast, in the last paper that he wrote describes algae that he had received from the Himalaya (1881).

William Joshua (1828-1898) described (1886) Desmidiaceae of a considerable collection that Dr. Robert Romanis had sent to him from Rangoon. William Barwell Turner's FRESH WATER ALGAE, principally Desmids of India, appeared in Stockholm in 1892. Professor **Antonin Hansgirg** collected in the Bombay Ghats ; and his collection was worked through by **Wilhelm Schmilde** (1900). In 1896-1897 **William G. Freeman** took rather extensive samples from various places in western Ceylon and from under various conditions. Freeman's sampling, probably the best sampling made before the century ended, was reported on fully by the two Wests, **William West** (1848-1914) of Bristol and his son Professor **George Stephen West** of the Mason College, Birmingham. The Wests' report on the Ceylon Algae was followed by reports on Algae from various parts of India both by the Wests and by **Dr. Nellie Carter.** But right up to the early years of the 20th Century the Indian freshwater Algae were very inadequately collected.

Some collecting of fungi in Ceylon was done by **Odoardo Beccari**. He (1843-1920), as soon as he had finished his University studies (1864), began to plan jointly with Marquis **Giacomo Doria** the first of his collecting expeditions to the Malay Archipelago. Together they set out in the next year and there was a halt in Ceylon when a small collection of fungi was made.

The reader will find more details regarding fungi than are given here in a paper by Sir Edwin Butler and Dr. Bisby in the first of the Science Monographs of the Imperial Council of Agricultural Research, 1931.

5. A GREAT STEP FORWARD IN THE BOTANIC LABORATORY : THOUGH VERY HESITATINGLY TAKEN

Laboratories are of many kinds ; but our interest is in none until dedicated temporarily or otherwise to botanic work.

The word ' laboratory ' had obtained recognition as meaning a workroom for chemical investigations and other work requiring apparatus. What was new in the use of it in India was not the holding of apparatus, but the idea of needing a building to hold apparatus for the purposes of Botany. The medical schools, powder factories, museum of the Asiatic Society, etc. had had need of a room set apart ; Jacquemont describes a chemical lecture given in Calcutta in 1829 which implied a chemical laboratory. Without Mycology the appearing of the botanical laboratory in India would have been even later than it was.

David Douglas Cunningham (1832-1914) entered the Indian Medical Service in 1868. He and another entrant, T. G. Lewis, were not forthwith sent out to India in the usual way, but were marked off for a little further learning ; they were sent to Berkeley to see him at work and then sent to Germany to see Professor Anton De Bary at work. We have seen Berkeley at his life-work—the taxonomy of the Fungi. Why were these two entrants to the Indian Medical Service sent to Berkeley ?

De Bary had published two years earlier one of his books—his MORPHOLOGY AND PHYSIOLOGY OF THE FUNGI, LICHENS AND MYXOMYCETES, a book which he himself said had been well received and had paved the way for further advances. De Bary was a master of method of laboratory study of the Fungi and other Lower Plants ; Cunningham would be able to see life-histories under investigation in the most fertile conditions.

The two entrants into the Medical Service were sent to other centres of research also. They went to India in 1869 ; doubtless the better for what they had seen ; though their delegation might be taken for an intention to promote a study of the fungi, their careers were not directed towards that. Cunningham's first laboratory in India was pathological and only mycological in an incidental way. In 1885 there was a redistribution of work which affected both. Lewis was called to the India Office in London and Cunningham nominated Professor of Physiology in the Medical College, Calcutta. He controlled a laboratory of course ; and in that laboratory carried out some very interesting mycological investigations. Sir David Prain, who saw Cunningham's work in progress, classes his mycological writings as recreations of an active mind, ' either questions which attracted his attention as a teacher of Physiology or subjects in which his interest was the outcome of his early friendship with Berkeley and De Bary.' The reader doubtless appreciates that whatever were the thoughts of the Government that sent him to see these two, there was no official dedication of him to Mycology ; but he kept his laboratory in part mycological. King had asked that a Mycologist be added to his staff ; but had not received one. Cunningham was a good friend who could and would do work for him at times, but his health broke down in 1897 and he was invalided out of India. In 1880 he had acted as Superintendent of the Calcutta Garden.

Four years after Cunningham had been attached to the Calcutta Medical College **Arthur Barclay** (1852-1891) entered the same service and was appointed Professor of Pathology in the College. He, too, commanded a laboratory which though dedicated to a different purpose, provided him with room for mycological work.

Barclay specialized on the Rusts of Wheat. He died in India in 1891, having been the Professor of Physiology in the Calcutta Medical College from 1874.

Two years after Cunningham's arrival in India, and the same before Barclay's, a parasitic fungus had appeared on the coffee bushes in Ceylon; and this, *Hemileia vastatrix,* was destined to bring another mycologist eastwards. The mycologist was **Harry Marshall Ward** whose career as a teacher of Botany brought mention of him into section 2 (see p. 52). The rapid spreading of *Hemileia* had been alarming ; it girdled the World in 25 years—whence its sudden vigour is not clear. At length (1880) the Ceylon Government determined to find funds for an investigation in Ceylon. Now (1880) for the first time a laboratory was set aside in the East completely but temporarily dedicated to Botany. In it Marshall Ward did superb work on three or four different fungi and a lichen ; but the coffee-disease had gone beyond control, as every villager's garden was full of it.

He returned to Britain and held among various professorial posts that of Professor of Botany at Cooper's Hill. Marshall Ward's work drove into the minds of the least philosophical of administrators and planters this—that there may be circumstances when a botanical laboratory has an overruling value. In 1897 the planters of Cacao in Ceylon, troubled as to their crops, engaged the mycologist **John Bennett Carruthers**, which meant providing the service of a laboratory, and in the same year the tea-planters in Assam engaged Dr. **Harold H. Mann** for their crops for work, at first conjointly with Sir George Watt, on pests and then with a laboratory for whatever he saw needed attention. In 1900 Dr. **John Christopher Willis** (1868-1957), who had succeeded Trimen in 1896 as Director of Peradeniya, sought to make mycological work at Peradeniya permanent by the appointment of J. B. Carruthers as Assistant Director and Mycologist.

The Botanical Laboratory with this began to be a mark of advance at large characterizing colleges as well as research institutions.

The indigo-planters later, but too late, engaged experts of their own.

6. BY WHOSE BOTANIZING CAME THE RECOGNITION OF AN UNLIKE FLORA TOWARDS THE PERSIAN GULF

An observant traveller from Gujarat to Sind is readily aware of passing into an altered vegetation. This altered vegetation is Persian. Botanizing in Sind was impossible before 1838 ; but in that year **Vicary** was sent thither with his regiment ; and **Griffith**, deputed from Calcutta, entered the northern edge, later to be the Upper Sind Frontier. Griffith was not again in Sind ; but Vicary was, and he wrote three papers on the vegetation. Next **Ritchie** visited Sind ; then **Stocks.**

John Ellerton Stocks (1822-1854) had been a pupil of Lindley in London and went to Bombay in 1847, where he was employed as a vaccinator in Sind. In 1848 starting from Hyderabad (Sind), where he verified the Assyrian method of pollinating dates, he ventured into the Las-Bela District of Baluchistan. Two years later, ascending the Indus to the Upper Sind-Frontier District, he passed through Nushki and Kalat to Quetta (Shawalkot). He wrote to Sir William Hooker that he had collected 300 plants new to him. He explains further that in traversing the Zawa pass and returning through Zehri he saw change in the vegetation. Both places are to the south of Kalat. What this implies is that Stocks had detected the passing over of the flora of Persian type which occupies southern Baluchistan and Sind into that of Afghanistan.

Stocks took his collections to Kew in 1855 where Bentham was prepared to work them out with him ; but he died in the next year. Sir Joseph Hooker has said of Stocks that he was a collector so observant that he scarcely missed anything.

During the seventies two other men collected to good effect in Sind ; and the collections that they made were given to Kew in the year 1877. One was Captain **William Stackhouse Church Pinwill** (1835-1920) whose regiment was stationed there. At the time he was an indefatigable collector, not only of plants but of animals of various groups. He collected also in Malacca. He left the army, inheriting property in the extreme south-west of Britain and the enthusiastic collecting was redirected into an equally enthusiastic accumulation of growing plants ; he indeed became a great horticulturist.

The second was his brother-in-law, Archdeacon **Stead** of Bombay.

Two very highly placed administrators, both Commissioners in their time, were among the next collectors of plants of the Sind flora—Sir **Bartle Frere** and Sir **Henry Evan Murchison James.**

Many of the plants that occur retain their positions by means of water which rivers bring to them and their drought-resistance is very interesting. So too is the fight of the field weeds to keep a place. I would call my reader's attention to the collecting along the rivers by Father **E. Blatter** and **T. S. Sabnis** in order that more may be done in this ecological line.

After the year 1900 this intrusive flora of Persian type was studied as it occurs in southern Baluchistan.

7. BEHIND THE PERSIAN FLORA IS THE AFGHAN FLORA

The Afghan flora has attracted considerable attention. The first to collect in Afghanistan was **John Martin Honigberger**, a man to whom adventure seemed irresistible. He was born in Kronstadt, Transylvania ; and in 1815 left his home to practise medicine and surgery for various periods in Constantinople, Cairo, and elsewhere and continued, until in 1833, he found himself on the Indus at Dera Ghazi Khan where he joined a caravan starting for Kabul. The caravan took him north to the Kurram and thence to Ghazni and Kabul. He collected a little, but the weather was at its hottest and conditions unfavourable. His few specimens he took at a later date to Vienna and Endlicher described them in his SERTUM CABULICUM.

A second period in India followed, during which he studied the Indian Materia Medica extensively, and, employing an artist, figured the plants in his THIRTY-FIVE YEARS IN THE EAST ; but it was no longer Afghanistan in which he worked, but chiefly Kashmir.

The next botanist was **Griffith**, who reached Quetta by the Bolan pass in the spring of 1840. He was at Kandahar on the first of May and then passed by Ghazni to northern Afghanistan to spend the rest of that year and the next year collecting diligently, getting aid from friends and employing local men. There was a trip to Bamean and a trip to Saighan and a trip up the Kuner Valley. In fact Griffith would have allowed little to escape him in the latitude of Kabul. As to the south he had friends there too, who collected for him and added to what he himself had obtained of the spring flowers. But the botanist of that part of the Afghan flora was J. E. T. Aitchison.

James Edward Tierney Aitchison (1838-1898), with a degree in medicine, had entered the service of the East India Company in 1858 and was sent to the Punjab where he started studying the plants at once. In 1865 he published a list of what he had observed in the Jhelum District, Thomas Thomson helping him to name them. Six years later he published a list of what he had found in the Hoshiarpur District, followed by a list of the plants of the Punjab and Sind. He returned to the Jhelum District and to Rawalpindi, but was soon sent to Leh in the Upper Indus Valley on an economic mission which resulted in his HANDBOOK OF THE TRADE PRODUCTS OF LEH (1874) ; then he had a short time in Hazara. These many charges with their considerable experience ended now in a permanent dedication to the eastern and south-eastern margins of Afghanistan. The collections that he made then were worked up at Kew, conjointly with Dr. W. B. Hemsley, into a valuable report.

In the year 1876 Quetta became the centre of civil administration. There was a collecting of plants also by two medical officers, **Oliver T. Duke** and **H. Hamilton**, who sent what they collected to the Calcutta Garden. Duke collected as far south as Kalat. In 1877 Colonel **J. W. Johnstone** collected a little at Kandahar and Kalat-i-Gilzai. By 1884 it had become possible to put the fuel and timber supplies under control ; and **John Henry Lace** was appointed Deputy Conservator. He made considerable collections in the area under him until 1888, and an account of them was published for him by the Linnean Society. In 1888 Sir Robert Sandeman had straightened out the affairs of the area of the Zhob river, east and north-east of Quetta, and Duthie, who had paid a visit to Quetta, was able to send his collector Harsukh into that part of

Baluchistan. In 1896 there was another Boundary Delimitation Commission on which Surgeon-Captain **Frederick P. Maynard** collected along the border west of Quetta. He in conjunction with David Prain reported on the collection. Maynard's work had extended towards Persia. After 1900 Baluchistan in general was collected over by Mr. R. **Hughes-Buller** and Rai Bahadur Diwan **Jamiat Rai**, and their results were incorporated by the writer into an enumeration of the Baluchistan flora published as a supplement to the Baluchistan Gazetteer. The southern Afghan flora appeared now to be fairly well-known ; to the names of collectors of it are to be added those of two more army officers, **Henry Appleton** and **Edwin Pierce.**

8. Ascertaining what the Himalaya shuts out from India

The abruptness of the Himalaya brings the flora of the upper or gritty Tibetan plateau to a position against the real Himalayan flora ; but in Kashmir the long range of snowy peaks on the north of the Vale has been interjected and is like a parting fence. It is interesting historically that botanical investigation should have found so much favour behind the fence.

The reader will recall that in 1812 the Government's veterinary officer, **William Moorcroft** made a dash through the Himalaya of Kumaon to procure shawl-wool goats (see p. 869 of chapter I). In 1819 he endeavoured to reach Turkestan that he might procure horses. On this occasion he was not on an expedition with a directing official but, on his own responsibility and for rather obscure reasons, he began by proceeding through Kulu to the Upper Indus, where he lingered. A little bundle of dried plants sent to the Calcutta Garden was the result of the lingering—plants which would seem to have been to Moorcroft curios. Among them was *Gentiana moorcroftiana* from Dras, which village he would pass through when in 1822 he left the Upper Indus to reappear in the Vale of Kashmir. The date was 10 years before **Jacquemont** botanized in the Vale ; it was the year of the building of the first permanent house at Simla and two years before the Garden at Saharanpur was reconstructed. Only when those 10 years were over was further botanising to be done. Jacquemont did not penetrate as deeply ; he entered the Vale via Punch and Baramula, collected through the summer, and left by Jammu when the winter came. **Godfrey Vigne** obtained entry into Kashmir in 1834. He was a leisured traveller who claimed to carry a plant press on his journeys, but probably used it only on a few occasions. He had entered the Vale by Jammu and thence crossed the Snowy range to the Upper Indus ; he was in Srinagar again in 1835 where he met **von Hügel** who likewise had reached the Vale by Jammu. The two left together by Baramula and Hazara, after a little exploration near Srinagar undertaken while von Hügel was packing and sending to Bombay collections which would seem to have held little botanical. Vigne went back to Kashmir and again into the rift of the Upper Indus, and there he met Falconer who had entered the Vale from Hazara (1836), had wintered there, and had taken the road northwards through Tragbol. Falconer, as one knows, collected in that year diligently ; and Vigne, then or afterwards collected in Astor. Falconer's plants would represent the first serious botanizing in the Rift of the Upper Indus ; they were fated to be kept for working out until Falconer could take them to London and after that to lie in the store of the India House until 1865 when Sir Joseph Hooker succeeded in getting them out, somewhat the worse for the passing of time. Vigne's plants were taken to Royle in England, the worse for not having been well collected or from rough handling.

Simla was becoming an attractive base from which to go into the Himalaya to its north. **Edgeworth** did so, collecting in Kulu and Chamba ; his friends **Lance** went to Ladak and Lord **William Hay** went to Lahoul.

James Edward Winterbottom visited Kashmir at the time when Thomas Thomson was there. It was a short visit and not quite along the Rift ; but to Astor where the upper Indus wriggles out of its confinement.

A few words may be said here regarding the juxtaposition of the exit of the Indus to the peaks of Nanga Purbat. It has been pointed out that such juxtaposition is to be expected for the supply of snow which the peaks secure, and therefore the supply of water to be run off, intensifies the grinding power of the streams it feeds. It is therefore not to be thought that the appearance which the Indus has of cutting the corner comes from some remote period of greater volume in the river above the corner, but can be explained without supposing that. There are three kinds of plants among these peaks : the melt-water species whose vegetative season climbs the hill-side behind the thaw of the winter snow, the short-lived annuals which are followers of man, and the xerophytes. The earlier collectors scarcely appreciated this ; but Thomson did point out what melt-water meant in the maintenance of flowering plants on stream sides.

Thomson went north from Leh to the Shyok Valley and the Nubra Valley, reaching the passes of the Karakoram. He was followed (1854) into these desolate regions by the brothers **Schlagintweit.** These three brothers, Hermann, Adolph, and Robert, were financed by the King of Prussia and their occupation was chiefly physical geography ; but they collected plants also, though their collections not being in the first line only very tardily received attention in Europe. Adolph was seized and killed by a rascal in rebellion at Kashgar. The other two worked on until 1858, their area of work the upper parts of the rivers of the

Punjab, the Tibetan plateau to Gartok, and the Karakoram. The next interest in the area came after an interval of 10 years. The Chinese had lost their overlordship of Kashgaria and their traders had been driven away. This produced a great shortage of such things as tea which had been coming to these parts from China. But it could also come from the new industry of the lower Himalaya by caravans trading from Kashgar to the Punjab in increasing numbers. For their convenience a market had been established at Palanpur, north of Amritsar. Contact with these traders caused a Kangra tea planter, **R. B. Shaw**, to adventure back with some of them to Yarkand. A request for official contact followed. Two embassies were sent, the first in 1870, the second in 1874, both under Sir Douglas Forsyth. Each embassy had a Surgeon-naturalist and the second had other scientific officers. The embassies went through the Vale of Kashmir, over the Zozi pass, up the Indus to Leh, and then over the Karakoram, varying the way a little after reaching the Tibetan plateau. As surgeon-naturalist on the first was **George Henderson** (1836-1929) ; we hear of him later as acting Superintendent of the Calcutta Garden. As surgeon-naturalist on the second was **Henry Walter Bellew** (? -1892) who had seen service on several political missions around the eastern frontiers of India. **Ferdinand Stoliczka,** the geologist, who reached India in 1862 and died in 1874, was on the second ; he was taken ill in Tibet, and he died two marches short of Leh, to the great loss of Geology, for he had made himself an authority on the structure of the Himalaya. While attached to the mission he had made several side trips as for instance to Wakhan. The missions were so timed that, by crossing Kashmir when the passes were free, they left Tibet soon after the entry of spring—too early for a part of the flowers. The reader understands that the stationing of Aitchison at Leh, summer and winter, in 1874 was connected with the consent to send these missions. After all, the tea which Kangra produced was not liked in Kashgar and the trade in Chinese tea slowly came back. Bellew was observant enough to comment on the change in the vegetation at the Zozi pass ; already he knew the flora of the Vale from previous residence in it. The Vale had become a popular hot weather resort and now and then among the visitors would be someone who found an interest in the plants. Such was **W. S. Atkinson**, the entomologist, who collected at various places round the Vale shortly before his death in 1878 or 1879.

C. B. Clarke's longest collecting trip was through Kashmir in 1876. He had entered the mountains in 1874 from Kangra, 2 years earlier, going forward to Dalhousie ; but the journey of 1876 was much longer. Entering Kashmir at its eastern end he travelled through the Vale, then took the Tragbol route by Astor to the Upper Indus, across the Indus he visited Askole and then the Karakoram. From these journeys he took to Britain in the next year vast collections.

Forsyth's two Yarkand Missions were preludes to collecting in Tibet with Leh a centre from which the explorers set out or to which they came on returning. In June 1890 Captain **N. H. P. Deasy** and **Arnold Pike** crossing the Lanak pass went over the gravel plateau as far eastwards as the Choral Cho, which lake is roughly north of the Manasarovar lakes, and returned. In 1891 Captain (later Major-General Sir) **Hamilton Bower** and Surgeon Captain **W. G. Thorold** crossed Tibet from the Lanak pass eastwards well to the north of Lhasa and so into China, descending into the lower plateau at the position where the Brahmaputra leaves Tibet. In 1895 Sir **Martin Conway** explored the Karakoram defiles north of the Lanak pass. In October of the same year Mr. and Mrs. **St. George Littledale,** who had crossed the Thian Shan in February of that year, completed the arduous part of their journey at Leh. In 1896 Captain **M. S. Welby** and Lieutenant **Neill Malcolm** left Leh on a route parallel to that of Deasy and Pike, crossed the whole upper plateau, and descended on to the lower plateau, where there was a carpet ' everywhere of good grass, flowers and wild onions, rhubarb and game ', in the month of August. These expeditions and the plants that were collected on them are very fully discussed by Hemsley in a paper published by the Linnean Society in 1902 (*Journal* 35, pp. 120) to which the reader is referred. What I wish to do here is to take these statements from Dr. Hemsley's paper : Above 16,000 feet 282 flowering plants and one fern are reported to grow, of which 53 belong to the Compositae, 30 to the Gramineae, 23 to the Cruciferae, 19 to the Ranunculaceae, 18 to the Leguminosae, 11 to the Caryophyllaceae, and 10 to each of these—the Crassulaceae, Gentianaceae, and Labiatae, also 9 to Polygonaceae, and 8 to the Cyperaceae. Bulbous species are few in number but as there is a part of eastern Tibet where *Allium* is so common that the country is called ' the onion country ', there seems nothing against the bulb as a way of survival.

Hemsley, having called attention to the Compositae being present in more species than any other family, showed that this is so for the floras of the Karakoram, of Gilgit, and of the Yatung in the back of the eastern Himalaya.

While the adventurous explorers, who have been named, were exploring Tibet, certain botanists were paying attention to the flora where the Indus bends southwards. Collections made in Baltistan by Captain **Hunter Weston** and by Dr. **A. Neve** (1895) reached Kew in 1890 and 1898 respectively ; and the first named was in touch with Duthie in Saharanpur. Gilgit to this time had attracted other collectors ; **C. B. Clarke** visited the Gilgit Valley in the very long tour that he made in 1876. Colonel **H. C. B. Tanner** did so in 1880 ; Dr. **G. M. J. Giles** went there for a long stay in 1886 ; **J. F. Duthie** paid a visit in 1892, and so did Professor **Paulus Johannes Brühl** of the Shibpur Civil Engineering

College. Colonel Tanner's and Dr. Giles's collections were large, and the latter who was able to make excursions beyond the Gilgit Valley had reached Wakhan. In 1895 there was an expedition to meet the Russians in the Pamirs, on which Captain **Alfred William Alcock** went as surgeon-naturalist.

Though the phyto-geography of the western end of the Himalaya needs much study yet, it is convenient to recognize as the Trans-Indus Himalaya an approximately rectangular block with the Indus on the east, the Kabul river on the south, and Russian Turkestan completing the other two sides. Chitral is towards the back of this rectangle. In the last years of my period the rectangle had needed military occupation along with parts of the mountains of Afghanistan, and it is interesting to record to what a large measure officers whose duty kept them in these wild mountains found the collecting of plants a relief from the tedium of their watch and ward. The names of the following can be found on herbarium sheets of these years :

Field Marshals Lord **Roberts** and Sir **Arthur A. Barrett,** Sir **Francis Younghusband,** Sir **Henry Collett,** and Sir **William Gatacre,** Colonels **Henry Halcro Johnston, Davidson, Mainwaring, H. H. Rich,** and **Wingate,** Captains **Hare, Harriss, Marsh, Milne, Pirie, Skey,** and **Wright,** and Lieutenant **Sidney Miles Toppin.**

Six of these, Sir William Gatacre, Colonels Rich and H. Johnston, Captains Harriss and Wright, and Lieutenant Toppin, collected also on other occasions, and Colonel Johnston (1856-1930) possessed a herbarium of his own which, after his death, was given to the Garden in Edinburgh.

The Afghan flora laps round the end of the inner north-west Himalayan flora and then appears to have its own end tucked into it. But there is a great deal of disentangling to do towards sorting out the components of the vegetation. Duthie's collector **Inayat** by visits to the district of Hazara made extensive collections there. **James Ramsay Drummond** (1851-1921) collected largely in the submontane districts and gave his collections to Kew.

The following comment may be made here. The geologists have shown that there have been descents in the mountains of glaciers to 4000 feet below present altitudes and therefore periods of increased cold ; and G. S. Puri has discovered plant impressions in Kashmir of living species which at one time grew at greater elevations than they now do. Thus we have in considering distribution evidence of changes of the climate in both directions. Perhaps a few northern species were enabled to reach the Deccan by the lowering across the plains.

9. THE FLORAS OF FURTHER INDIA AND THE WAY IN WHICH A KNOWLEDGE OF THEM GREW

In the last three sections we have seen the way in which knowledge grew of a Persian flora that extended into India, a flora characterizing Afghanistan, and of the flora of the upper or gritty plateau of Tibet. It is time to do the same for the opposite or Assam corner.

India proper is rather symmetrical in the way it spreads as an isosceles triangle with the long angle pointing south, almost reaching the equator, and with the Himalaya from west to east in the north. Warm seas make the southern complete boundary ; frosty and very high mountains make the less incisive but yet incisive northern boundary ; and there can be a great range in climate on the score of temperature, which is mixed with room for a like range in humidity. Under the Himalaya at either corner the isolation of India is modified by continuous land, a consociation of lowland and mountain which has allowed plant migration through it to a degree which must interest a phyto-geographer. The passage way towards the west is half as wide again as the passage way towards the east, the addition of width being towards the north. Favoured by the width, passage towards the west would seem to have been more penetrable during climatic change than the passage towards the east, but climate rules.

Of the two floras which today plug the passage towards the west, the Afghan flora is montane and the Persian lowland ; but in the passage towards the east there is less difference due to elevation. Exactly what this amounts to is a matter for future work ; and therefore let us assess the incompleteness of our knowledge of the botany from the eastern Himalayas to the isthmus of Kra.

The first botanical specimens which reached any scientific destination were sent from Siriam in the delta of the Irrawaddy by **Edward Bulkley** to the East India Company in London. Siriam faces the site on which Rangoon was to be built some 50 years later. And after that a century passed before there was a fresh and better opening. Then (1793) **Francis Buchanan**, newly arrived in India, was attached to Captain Michael Symes's mission to the Burmese court at Ava. He collected in the Irrawaddy delta in the hot weather and ascended the river in the rains, returning in the cold weather.

After that he was stationed on medical service at Noakhali and gradually worked out his collections in correspondence with Roxburgh. From Noakhali he had a brief deputation to Chittagong and then a move to Baruipur, which to his satisfaction brought him within a day's journey of the books of the Calcutta Garden. In 1809 the missionary **Felix Carey** sent to the Garden dried plants from the neighbourhood of

Rangoon. In 1826 Wallich made the journey that Buchanan had made 22 years earlier ; he did yet more, for after descending the Irrawaddy he went to Moulmein and up the Salween as far as the East India Company's authority ran, and up the Ataran river to its teak forests. A very few years later the missionary **Francis Mason** arrived and was at first at Tavoy, then at Moulmein. There was in him that thirst for knowledge that characterized and drove forward the Serampore missionary Carey. Next **Griffith** arrived ; stationed at Mergui, Moulmein was within reach and he actually was there, for according to Griffith his collections ran to 400 species. A year after Griffith had been called away to join the Assam Delegation, **Helfer** and his wife arrived—energetic and diligent collectors. Helfer went to the Andaman Islands and lost his life in an attack on his party by a band of Andamanese (1840). His wife apparently returned to Bohemia. (See Kerr in *Journ. Thail. Res. Soc., Nat. Hist. Suppl.*, **12** p. 9.) In 1849 **Falconer** was sent to Moulmein to report on the teak forests. In 1857 **McClelland** was sent to Pegu to take charge of the forests ; and these in 1856 passed into the charge of Sir **Dietrich Brandis**, who in 1857 was also given charge of the Moulmein forests. About four years earlier **Charles Samuel Pollock Parish** had been appointed chaplain at Moulmein and he remained there until 1878, collecting and sending dried plants to Kew.

Before this activity, Griffith had made (1838) his journey down the Irrawaddy. The colony at Rangoon had been growing, looking after its own affairs and reached the state of maintaining a horticultural establishment.

Chittagong as to its flora is Burmese. Mention has been made of Buchanan's visit of a month's duration in 1798. Roxburgh had arranged also the visits of his sons William and John as he well knew the interest of the plants there. Later Wallich sent his collector, Henry Bruce, to Chittagong. But none of these contrived to explore in the interior. However a door was found further north and in this again water-carriage had a great influence — the way by water from the mart of Bengal into Sylhet was so convenient and useful. Along it the first botanical exploitation was made ; and we find in Roxburgh's day the magistrate **M. R. Smith** residing at Pundua (16 miles from Sylhet village) to which the hillmen would come to barter. It is evident that his dealings with the hillmen extended to getting plants for his own garden, some of which he would send as gifts to Roxburgh He died in 1819. To Pundua Wallich sent a collector, **Francis de Sylva,** who living on a boat could carry on collecting in a most convenient way. In 1826, the missionary teacher of Serampore, Professor **John Mack** (see Chapter II, Vol. 54, p. 45) visited the stations of the mission to the Khasis, presumably via Pundua, and he and his wife prepared a collection of dried plants which was a beginning. Sir Alexander Mackenzie records that 1826 was the year of the first political approach to the Khasis. **David Scott**, who has been mentioned as sending a scrap of a Camellia to Wallich in 1826 enquiring if he had in it the tea plant, was at the time the Governor-General's Agent on the north-eastern frontier, and in 1829 he suggested to the hillmen the convenience of a bridle-path down from the neighbourhood of Cherrapunji and at the further end down to Gauhati. Scott constructed for himself a house at Cherrapunji and the path was made. With the trouble that followed its completion we are not concerned, save to mention that the police officer Captain **Lister**, who had the business of restoring order, later did a little plant collecting. Scott died in 1832 and after a short break **Francis Jenkins** succeeded him (1834) operating from Gauhati. He was there when at the end of that year Wallich received through him a twig and admitted it to be the tea plant, an admission that caused the Assam Delegation to be planned, Jenkins taking a leading part. Of the alternative ways of reaching Gauhati, the river for the whole way or the river to Sylhet and David Scott's path through the Khasia Hills, the former wasted an opportunity of seeking the tea bush in accessible parts, and so Jenkins would have the Delegation cross the Hills ; from Gauhati there was no alternative but the river. Perhaps Wallich would have preferred to use the river all the way; Griffith certainly did not. And so the plateau received its first visit from a professional botanist. Griffith was destined to cross the plateau again and able slightly to vary his route. **Masters** must have used the road, for he travelled not a little when in charge of half the Company's patches of tea and he certainly collected as far away as Sadiya and in a journey into the country of the Angami Nagas. Griffith kept a paid collector in the Khasia Hills.

In 1851 **Hooker** and **Thomas Thomson** spent the months from May to November collecting in the Khasia Hills with great vigour and, when they left, Falconer had collectors there ; the Kew Collector **Richard Oldham** made a short visit in 1861, the geologist **Thomas Oldham,** the zoologist **H. H. Godwin-Austen**, and the physician Sir **Joseph Fayrer** as occasion offered would collect. **C. B. Clarke** was appointed Inspector of Schools, Assam, in 1883 and that connected him with Shillong until his retirement in 1887. Sir **George Watt** visited the Hills at the beginning of Clarke's years in Assam. The hills then and continuously afterwards served as a base for botany deeper in the Province. The tea industry brought fresh workers into it. Wild tea had been found in Cachar in 1855 and planting followed. Among the early planters was **Richard L. Keenan** who left Kew, where he had been training, in 1867, to become a tea-planter, and carrying with him his interest in Botany sent a consignment of dried plants to Kew in 1874. There is a reported abundance of wild tea on the Manipur-Burma boundary, where Watt later collected, but the difficulty of communications beyond Cachar arrested planting towards it. Few tea planters collected in the Brahmaputra Valley. One who did was **S. E. Peal** of Sibsagar. Further collecting was a little here and a little there, but nothing consecutive. Early in the time when any collecting was possible Griffith had gone some 80 miles into Bhutan on **Pemberton**'s mission—the season : late rains to the return of the rains—when he collected nearly 1600 numbers. On his short journey among the Mishmis in mid-October he collected nearly 1200 numbers. Smaller collections resulted from Booth's journey for rhododendron plants into the mountains just beyond Bhutan, ascending to 7000 ft. ; Colonel Lister's gathering from the edge of the mountains when occupied in a bloodless blockade of the Daphlas of the Dukrung Valley ; a little material from the zoologist Godwin-Austen, Griffith's collection from the more eastern Naga country; Collett's visit to Kohima in 1891 ; Prain's collections a year in the hills of the Angami Nagas ; J. Rollo's collecting of Bamboos, and the Calcutta Garden's collecting from the trace of the railway through the hills ; Griffith's rains and cold weather collecting about Sadiya and George Gammie's collecting there in 1894.

The collectors of plants for growing : **Thomas Lobb** was hunting for them on the Khasia Hills when Hooker was collecting. **Booth** soon afterwards came to hunt for handsome rhododendrons on the other side of the Brahmaputra Valley. Others followed.

10. SIR JOSEPH HOOKER EXPOSES IN A NEW WAY SOME OF THE PHYTO-GEOGRAPHIC PAST OF INDIA

When the FLORA OF BRITISH INDIA was done Sir Joseph Hooker was asked if he would prepare a review for the IMPERIAL GAZETTEER then in preparation, and he consented. No one living could have done it better than he. He recognized and admitted that what he had written in 1855, conjointly with Thomson, was now quite out-of-date. The two of them had then suggested 64 areas each characterized floristically, and these they had called ' provinces ' ; Hooker makes it quite clear in the new *Sketch* that he put them aside though suggestive. He now made a different approach ; he reduced the number of ' provinces ' to 9, as parts of three divisions of political India which he calls regions.

At the time when Hooker was commencing to write his *Sketch*, C. B. Clarke had prepared a paper on the geographic dispersal of the Cyperaceae in British India, and had read it to the Linnean Society as his presidential address (1898). His approach was through an Indo-Chinese area cut out of Asia, of which British India became a sub-area ; and the sub-area he divided into 11 sub-sub-areas. They had a close resemblance to Hooker's 9 provinces as the adjoining table shows :

Hooker's Provinces		Clarke's Sub-sub-areas	
Himalayan Region	Eastern Himalaya	Eastern Himalaya	
	Western Himalaya	Western Himalaya	
Western Region of India	Indus plains	India deserta	British Indian Sub-area of Indo-Chinese Area of Asia
	Gangetic plains	Gangetic plains	
	Malabar	Malabar	
	Deccan	Coromandel	
	Ceylon	Ceylon	
Eastern Region of India	Burma	Assam	
		Ava	
		Pegu	
	Malaya	Malay Peninsula	

Differences not obvious on the Table need not be detailed here : Hooker and Clarke had discussed them. Clarke excluded from his paper any botanic defining of areas and sub-areas, as being to his purpose no more than links with Geography.

The agreement between Hooker and Clarke is important as far as it means that both of them regarded sub-sub-areas as having dimensions appropriate for discussion, Hooker judging by the whole vegetation, Clarke by the family Cyperaceae which he had recently worked up for Hooker's FLORA. They may assuredly be accepted. Clarke's nomenclature is better than Hooker's in avoiding the word ' province ', which word from its very origin has belonged to political geography. But the term ' region ' is as elastic as ' area ' and is without political implications ; there is no objection to recognizing ' regions ', ' sub-regions ', and ' sub-sub-regions ' as in the following pages, should ' region ' suit the context better than ' area '. The two authors diverge widely in dividing or not dividing Hooker's Eastern Region and in the ways of dividing the Peninsula of India.

Hooker put an enormous amount of work into the collection of the data that he used. He would have liked a large number of plant-lists and had to compile many for his purpose. Having provided himself with lists, he scored them by the ten families with most species proved present.

A few pages back I have had cause to quote Hemsley on the flora of the upper Tibetan plateau in which Compositae come first and the families follow it in this order : Gramineae, Cruciferae, Ranunculaceae, Leguminosae, Caryophyllaceae, Crassulaceae, Gentianaceae, Labiatae, and Polygonaceae. Hooker's first 10 in all cases differ from the sequence of high altitudes in Tibet. I do not wish to quote all ; but I wish to indicate what a striking result can be reached, and in the following table quote eight lists :

	Ceylon, as a whole	Western Peninsula	Gangetic Plains	Indus Plains	W. Himalaya	E. Himalaya	Burma	Malaya of Hooker
Acanthaceae	7	3	7	..	..	..	6	..
Annonaceae	..	..	..	..	..	..	..	5
Asclepiadaceae	..	10	..	..	..	..	..	..
Boraginaceae	..	..	..	7	..	..	..	..
Compositae	8	8	4	5	2	4	9	..
Convolvulaceae	..	..	9	10	..	..	..	..
Cruciferae	..	..	..	..	8	..	..	..
Cyperaceae	4	5	3	4	4	5	7	9
Euphorbiaceae	6	6	8	9	..	10	5	3
Gramineae	1	1	1	1	1	2	3	6
Labiatae	..	9	..	6	5	..	..	..
Leguminosae	2	2	2	2	3	3	2	2
Malvaceae	..	..	6	6	..	..	..	..
Melastomaceae	10	..	..	..	..	..	..	8
Orchidaceae	3	4	..	..	7	1	1	1
Ranunculaceae	..	..	..	..	6	..	..	..
Rosaceae	..	..	..	..	9	8	..	..
Rubiaceae	5	7	..	..	..	9	4	4
Scitamineae	..	..	..	..	..	..	10	7
Scrophulariaceae	..	..	5	5	10	7	..	..
Urticaceae	9	..	10	..	..	6	8	10

The 8 columns carry the names of 21 families of flowering plants : of them 3, being Gramineae, Cyperaceae, and Leguminosae, occur in all the columns ; Compositae and Euphorbiaceae in 9 ; Orchidaceae and Rubiaceae in 8. I have arranged the columns to show that the families in which turf-making herbs abound are on the left and those in which epiphytes abound are on the right. In brief the table exposes the fact that the turf-herbs belong to the west side of India and the epiphytes to the east side. Why ?—climatic. Hooker was endeavouring to read back from present dispersal into geological time. Furthermore he had called attention to the existence of a Cupuliferous boundary line which runs along the base of the western Himalaya and at Bhutan turns south to the Bay of Bengal ; and now his new figures suggest another line, say from southern Gujarat to the Nepal Himalaya sagging southward in the centre—a line that under increasing dryness might sag right to the south of India, restricting without driving out the flora which Hooker calls ' Malayan ', or putting an end to the evolution of the seasonal Podostemaceae of the Western Ghats.

If that line at one time sagged enough on the map for this—and the patanas of Ceylon suggest that it did—it has retreated as well as advanced. The line anyhow is something that must be considered in discussions on that drying of India which certain other features demonstrate.

Hooker published further decads which do not illustrate climatic change at all, usually because the collections had not been spread over the whole year. If two lists be prepared and compared, one from Griffith's intense collecting when he spent 24 months in the Afghan area and the other from list of Aitchison's Kurram Valley collection, the first has the Acanthaceae in the sixth place and the second has Scrophulariaceae in the fifth place, neither getting into the decad of the other. And in regard to this the reader needs to be told that military exigences kept Aitchison out of his area in the spring, causing the periods to disagree. If Hooker's method is to be used, the periods and area must agree. The use of Hooker's device is most certainly recommendable but with considerable caution.

There is another confusion possible. It is obvious that genera such as *Impatiens, Pedicularis,* and showplant *Rhododendron* must greatly disturb the sequences in some areas. In their case evolution seems recently explosive so that their species have not the specific value safe to associate with evolution.

Clarke postulated a land-bridge from the Malay islands to Ceylon to account for the presence in both areas of certain sedges ; he did not bring to notice the alternative of a route round the Bay of Bengal.

I would that the reader should realize the tremendous but complicated interest of Hooker's line of investigation.

The *Sketch* was put into print in 1903 for the convenience of obtaining criticism ; then in 1907 it was published in the appropriate volume of the IMPERIAL GAZETTEER.

In 1903 Sir David Prain's BENGAL PLANTS appeared. He applied a terminology of his own to geographic areas in relation to Bengal. He accepted *India deserta* for the dry north-west, *India diluvia* for the Gangetic plains, *India aquosa* for the western coastal strip which the south-west monsoon soaks, *India vera* for the plateau east of it, *India subaquosa* for Coromandel which the dying monsoon saturates, and *India littorea* for the great Ganges delta and the lesser deltas of India's outline. Prain's terminology is climatic saving the last name. Professor Troup later gave another set of names which, though their date is 1921, I mention here lest they be overlooked.

Robert Scott Troup (1874-1939) entered the Indian Forest Service in 1897 and had had 9 years of experience in the best teak forests of Burma when (1905) he was transferred to the forest central station at Dehra Dun.

The Forest Service as far back as 1872 had taken to Dehra Dun their survey work. Already three years earlier Brandis had pointed out that the Service would need to teach at least its Forest Rangers and, when teaching began, the experiment was tried of giving it to apprentices sent to the Engineering College. Schlich, who had suggested this, was soon to come into contact with the result and found himself constrained to report that the new Forest Rangers back from the Roorkee College had acquired there much useful knowledge, but not in Botany. The upshot was that teaching was established by the side of the Forest Survey work and a large area of forest attached to the School, where, as recorded, J. F. Duthie would teach the young men to know their trees.

The Forest Service was irregular, experimenting with its working plans until 1880 ; then by way of improving work their preparation began to be regularized ; and the process led to specialization ending in transfer of the final and decisive stages to Dehra Dun. The next step was the setting up of a department for Research, and Troup, though he was not at first in charge of working plans, soon found his day to day work in them. The Forest Service had collected large quantities of data. Troup with these wrote his excellent SILVICULTURE OF INDIAN TREES. He had commenced it in 1916 ; he was called to Oxford in 1920 to the post of Professor of Forestry ; and the three volumes were published in the next year. The date of course is far beyond the end of my period, but to proceed without a reference would suggest that the work of Hooker, C. B. Clarke, and Prain had a sort of finality.

Troup's phyto-geography, founded only on the growth of forest trees—there are a little over 700 referred to or dealt with in great detail, led to suggesting these ' regions ' :

(i) Western Himalaya ; (ii) Eastern Himalaya ; (iii) The Trans-Indus ; (iv) the North-Eastern Dry Region ; (v) the Gangetic Plain ; (vi) the West Coast Region ; (vii) the Central Indian Region ; (viii) the Deccan along with the Carnatic ; (ix) Assam ; (x) Burma ; and (xi) the Andaman Islands. Like the sub-regions or sub-sub-areas there is as much definition in them from geography as from botany, or perhaps even more.

It is desirable that the nomenclature should come under criticism, and that botanists now in India should shape it, and that they co-operate with the climatologists for they have put forward classifications of India's surface that, differing in detail, should not be neglected. They suggest improvements : for instance, they take note of the equatorial air-regime by which there is rain twice in the year as the sun is twice at its remotest from the equator. Of this the phyto-geographers up to 1900 have taken no notice, although Ceylon and Kerala show its effects ; phyto-geographers, furthermore, before 1900 had not thought it proper to divide Ceylon into its dry and humid parts. Other improvements originating with them are recognition of a sub-Himalayan belt on the north-west of India, and a closer union between the Santal Hills and the Gangetic deltaic plains than had been conceded.

11. PLANNING IN CEYLON

John Christopher Willis (1869-1958) succeeded Trimen as Director of the Peradeniya Garden in 1896. Trimen, who had become a very sick man, was endeavouring in spite of his difficulties to complete his HANDBOOK OF THE FLOWERING PLANTS OF CEYLON ; and Hooker, his own FLORA OF BRITISH INDIA completed, had promised to see Trimen's HANDBOOK out. The situation suggested the end of a chapter to any involved in it, and of course particularly to the new Director with whom lay planning for the future. The Government of the island accepted his views.

The taxonomic work of the Garden was to be intensified as to the lower plants, and particularly towards the fungi for economic reasons : the disaster of the coffee-leaf disease impressed that. Further, for the security of existing crops provision for the entertainment of an entomologist was made ; and for miscellaneous enquiries needing the attention of a biologist the entertainment of one who acted as an assistant to the Director and, as the occasions for requiring his research could not be predicted, was to be as it were on post-graduate research within a period of three years.

The three, a mycologist who was to be at the same time Assistant Director, the entomologist, and the post-graduate engaged on research were laboratory workers whose results depended on development of buildings in the Peradeniya Garden.

I have called my reader's attention to the creation of a high level plantation in 1860 when the introduction of Cinchona was contemplated. This, the Hakgala Garden, preserved also a sample of the vegetation characteristic of its zone on the mountains. In 1876 another plantation was required, a hot humid one for the accommodation of the rubber tree, *Hevea brasiliensis*, from the Amazon ; this, the Heneratgoda Plantation, also held a sample of the local jungle. Naturally these were used for lesser experiments—the way plants unsuited for Peradeniya would behave in the climates of these plantations. They are called gardens officially, and botanical work was theirs in this geographic way. About 1880 the whole of Peradeniya was landscape-gardened. In 1886 another plantation was established, that of Badulla, hot and relatively dry, with a dry season between July and September instead of that between January and March of the Colombo side of the island. Yet another plantation was made, that in the dry north at Anahadrapura.

This useful dispersal of trial grounds was to be somewhat increased. There was a small school of Agriculture in Colombo and proposals came forward to close it in favour of something more ambitious on the Gangaruwa estate alongside Peradeniya. The estate had been owned by the Governor Barnes who, having opened the way for the coffee-planters into the hills by making the Colombo-Kandy road, had grown coffee, indigo, and sugar-cane on his estate. It was now to hold demonstration plots, and agricultural practice regarding them was to be taught by the officers of the Garden staff. The illiterate peasant, it was hoped, would learn new ways through those who had learned them at Gangaruwa. Meanwhile he was to learn through school gardens and then a teacher using a vernacular language of the island was chosen as a demonstrator for the schools.

There was a planters' magazine in the island ; this, taken over and entrusted to Willis as editor, sufficed along with Circulars to keep the literate in touch with the progress of the Gardens. As an outlet for the Gardens for scientific research, Willis arranged for the publication of a journal in pure science—the *Annals of the Royal Botanic Gardens, Peradeniya* ; and the first part appeared in June, 1901. In it he gave an account of his planning to that date. When later the duty of education was entrusted to him, he began to call his charge a department of Agriculture. Then someone else planned, seeking to place Agriculture over Botany ; this came after Willis's department had been growing for a decade and so was outside my period but I have to refer to the way in which it broke up Willis's planning, leading him to retire.

The speed of a convoy is that of the slowest unit in it ; the slowest speed of Willis's convoy was that of the unit of the peasant's education.

Ceylon is on one of the busiest of ships' highways and for some time before Willis's appointment botanists of various nations had, as it were, looked in if they had the opportunity. Some of them were on their way to the Netherlands Indies to undertake research, and the Dutch provided facilities for their work. Willis, taking a lead from this, planned to do the same at Peradeniya. He wrote : ' it would be difficult to exaggerate the value of travel in other countries to the working botanist, especially if his work lie in the departments of systematic botany, geographical distribution, ecology, morphology or economic botany, whilst to the physiological or anatomical worker there are also innumerable problems which can only be solved by research in tropical countries.' He sought to make it easy for students new from British centres of teaching, and their teachers too, to visit Ceylon as others were visiting Java, to learn how the plant lives in the tropics—a knowledge which really is essential—and got sanction for an extension of his laboratory facilities to make work easy. It had been necessary to create working room for Marshall Ward when the coffee-leaf disease needed investigation ; Willis would have the working room ready in advance. But visitors from Britain had come without waiting, some with grants for travel.

Willis assembled his staff. But on the horticultural side the two chief men were already there—(i) **William Nock** who had been acting Director from the date of Trimen's retirement and who on Willis's arrival went back to his substantive post at Hakgala, and (ii) **Hugh Fraser Macmillan** who had been sent out from Kew in 1895. H. F. Macmillan (1869-1948) took charge of the horticulture of Peradeniya when Nock went back to Hakgala. From that year until 1912 he held this position ; but in 1912 with the passing of Peradeniya under a Director of Agriculture he was given charge of all the Department's horticulture and had the title of Superintendent of Gardens. His 30 years in Ceylon enabled him to write his TROPICAL GARDENING (1912). **John Parkin** had arrived in Ceylon by an understanding with Trimen ; and to him was given the new three-year post of Assistant to Director. A disease of Cacao had alarmed the planters of that crop and they had invited **John Bennett Carruthers** (1869-1910) in 1891 to Ceylon to seek for remedies. The Government accepted him as their Mycologist, coupling with that post the post of Assistant Director of the Garden. **Ernest E. Green** was in the island investigating insects, chiefly pests, and was attached to the staff. The research work of these three was such as would be done in a laboratory, and so was also the work that the Director expected to do apart from administrative duties ; and so Willis planned to facilitate the research of visitors by providing laboratory accommodation for them too. Willis went on to get chemists attached to the Garden. The plans for the education in agriculture took time to shape and, except that the Garden's officers were to teach, could have been separate.

Parkin joined the Director for work on the bleeding of rubber trees and joined Pearson in research on the plants of the patanas. At the end of his period he gave place in 1900 to **Herbert Wright** (1874-1940, knighted in 1930) whose future economic interests were shaped in Ceylon, partly as the Assistant to Willis and then as Controller of the Peradeniya Experimental Station (1904-1907).

Carruthers left Ceylon for Malaya in 1905, **T. Petch** succeeding him as Mycologist and remaining until 1906. So far the intensification of the taxonomic work of the Garden towards the fungi has had a favourable development.

Willis entertained no doubt as to the nature of the department entrusted to him ; it was to be brought into line with such departments as that of the Dutch in Java and reflect the thought of lively European universities as far as possible. The island could teach many lessons in the way that tropical life moves.

Here is a list of eminent botanists whose visits proved this awareness :

Karl I. E. Goebel, Assistant Professor at Strasburg, visited Ceylon in 1886 ; Michael C. Potter, when teaching in Cambridge, in 1888 ; Wilhelm O. A. Tschirch, a professor of Berlin, in 1888 ; John Bretland Farmer from London in 1891 ; Frederick W. Keeble, a post-graduate student of Cambridge in 1893 ; Carl Holtermann from Berlin in 1895 ; Hans Molisch, a professor from Prague, in 1897 ; Henry H. W. Pearson, a post-graduate student of Cambridge, in 1899 ; J. Stanley Gardener also from Cambridge in 1899 ; Andreas F. W. Schimper from Basel in 1899 ; K. Giesenhagen from Marburg in 1899 ; Arthur George Tansley and Felix E. Fritsch together, from London, in 1902. The list might be made longer ; but from it the reader understands that botanists of the new school were very well aware that to visit the tropics was expedient. I have excluded from it others who came to collect as Otto Warburg (1881), Wenzel Svoboda (1886), and Gustav F. Radde (1890). The first visited many parts of India collecting economic plants. Willis embarked on a morphological and taxonomic study of the Podostemaceae, for which he had excellent material in the river Mahaweliganga close at hand and for the furtherance of which he made two journeys in India, one to the Bombay Ghats and the other to the Khasia Hills. The value of his work was great ; as to the geographic dispersal in the East which the work detailed, there was a connection with that of Hooker which I have pointed out in section 10 (see p. 74) and which did not emerge at the time.

The conditions under which Podostemaceae can grow are limited by their seasonal need of torrents ; therefore their dispersal proves a past climate of contrasted seasons dry and wet in alternation for ages long enough for their establishment. Applying what this shows to the knowledge that climates within the peninsula of India have oscillated, we have it clear before us that the margin of the Peninsula has never failed, since Gondwanaland went to pieces, to retain its wet seasons while the inner parts went dry.

Willis did not succeed in finding Podostemaceae in Sikkim, but they are now known to occur in at least one part.

What was the dying condition of Gondwanaland when the condition of India, bordered by deluge-monsoon-needing Podostemaceae, took its origin ?

In 1907 a serious accident terminated Willis's field work. His administrative planning, than which there was nothing more advanced in India, had made its mark and it is for another to assess the effect of the counter planning to which I have alluded.

When Willis was appointed to Ceylon, the Forests were in charge of A. F. Brown, who had written an account of the forests as an appendix to Trimen's HANDBOOK. He was followed by Frederick Lewis, who, like Bourdillon in Travancore, had been a planter at one time. A planter with a botanical interest, who was in Ceylon at the time, was John Foot Jowett. Passing mention is due to J. Miguel Silva, plant collector at Peradeniya under Trimen and for twenty years after Trimen's death. His name becomes familiar to any botanist interested in Ceylon collections.

12. A GREAT STRIDE FORWARD COMES THROUGH THE UNIVERSITIES

At the end of section 5 attention was called to the setting up in India of laboratories to aid or guide certain large industries. It had seemed, when Dr. D. D. Cunningham was sent to see Miles Berkeley at work and to visit various teaching institutions in Germany where the study of Fungi was active, as if he was to link his work with the greatest industry in the country, namely the raising of food crops ; but that was not to be ; Sir David Prain, a most intimate friend, states that Cunningham's work with fungi, when it came, originated without attachment to economy. In 1878 he was publishing on the way in which a living organism, whether animal or plant, meets starvation. This was followed by other work as purely scientific, which gave to Cunningham the place of a pioneer. The next pioneer after him was Marshall Ward, who went to Ceylon in 1882 on a two years' agreement originating in a definitely economic enquiry, but which gave him the opportunity of making investigations of great general import in pure science. Marshall Ward left Ceylon in 1885 when his mission was finished ; Cunningham left India in 1897, broken in health.

It was shortly after this that Professor Jagadis Chunder Bose (knighted later) turned his attention to the perceptions of plants. He had been led into making observations by physical work which at first he had in hand in London ; and then he took the prosecution of it to his University laboratory in Calcutta.

The reader sees that the entry of the botanical research laboratory into India, which ensued through the three old Universities, was at the very end of my period. That being so, I shall not follow its course more than to refer the reader to a publication by Professor P. Maheshwari and R. N. Kapil (*Journ. Univ. Gauhati* **9** (**2**), 1958) in which are named the Universities and University Colleges whereat courses in the Science of Botany are given. My chapters are not for the scholars of these teaching establishments but for the botanists engaged in taxonomic research ; and the proper place for them is not the class-room but the herbarium work-tables, as four-fifths of the names in them are the names of men who collected plants and by their collecting not only established the make-up of the flora of India but got together also a fair amount of information on plant-geography. I began a card-index when engaged on herbarium work in India and it ultimately became a foundation for these chapters. As to completeness I think very few names can have been omitted. The chapters could have been headed ' A record of the growth of systematized knowledge of the plants of India '.

I had not in my mind, when determining that my narrative should end at 1900, the fact that Reynold Green's HISTORY OF BOTANY IN THE UNITED KINGDOM ends at the same date. But so much the better, for my chapters become a chronicle that can be read along with that excellent book.

(*To be continued*)

A small collection of earthworms from Nepal (Megascolecidae : Oligochaeta)

BY

R. W. Sims

British Museum (Natural History)

(*With a plate*)

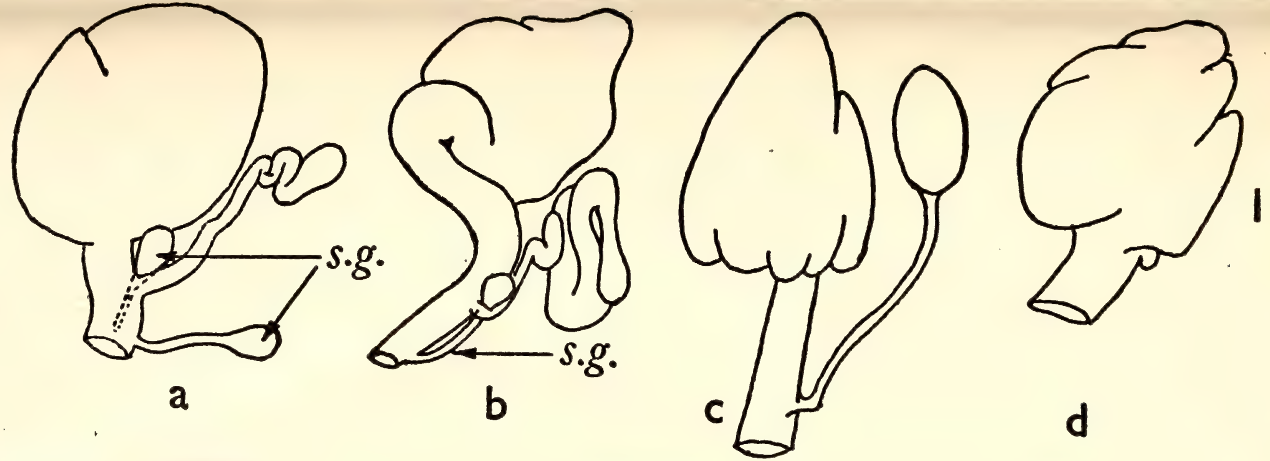
During October and November 1961, and March 1962, Dr. W. G. Inglis and Mr. K. H. Hyatt made a small collection of Megascolecid earthworms when in Nepal as members of the British Museum Nepal Expedition 1961-1962. Although only a few specimens were collected they were found to include some which are rarely recorded. It seems useful, therefore, to report on this collection particularly as it was made in an area from which material is seldom obtained. All of the worms were collected in the vicinity of Maewa Khola, Sanghu, Nepal (27° 21′ N., 87° 33′ E.). I would like to express my gratitude to Dr. Inglis and Mr. Hyatt for providing me with the material.

Pheretima campanulata (Rosa)

Perichaeta campanulata Rosa, 1890, *Ann. Mus. Genova* **30**, p. 115. Palon, Burma.

Under a damp stone, Maewa Khola, Sanghu, 6500 ft. 14 November, 1961, K. H. Hyatt. 1 clitellate specimen.

External Characters. Length 108 mm. Diameter 4 mm. Number of segments 110. The specimen which is preserved in alcohol, is a dark greyish brown colour. Prostomium ½ epilobous. The first dorsal pore is in intersegmental furrow 11/12. The clitellum is annular and extends over three segments, *xiv-xvi*; the intersegmental furrows and the dorsal pores in this region are missing, also the setae except for a few in *xiv*. The setal areas on the ventral surface of the preclitellar region are raised giving a triannulate appearance. Generally the setal rings are broken irregularly on the ventral surface. The number of spermathecal setae on *vii* is 11, *viii* 17; penial setae



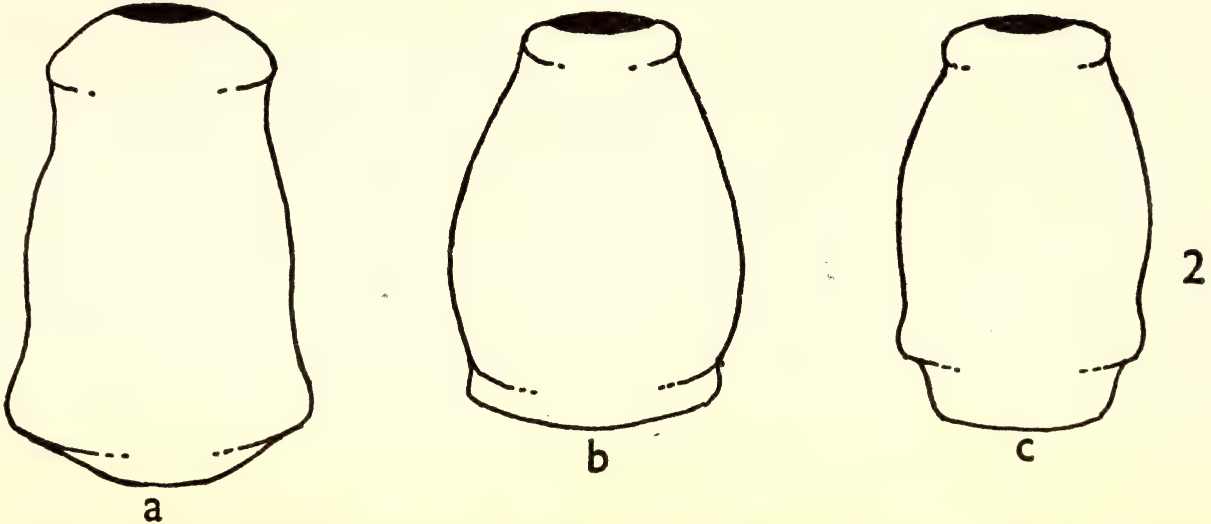


Fig. 1. Spermathecae (anterior view) : (a) *Pheretima campanulata*, (b) *P. houlleti*, (c) *P. diffringens*, (d) *Perionyx foveatus*. s.g., stalked gland. Fig. 2. Gizzards (dorsal view) : (a) *Pheretima campanulata*, (b) *P. houlleti*, (c) *P. diffringens*

xviii 11; setae *xx* 52. There is a single, median female pore on *xiv*. The male pores are paired and each lies within a copulatory chamber in *xviii*, the chambers are in the setal ring and each is closed by a medially directed tongue-like lateral lobe. The spermathecal pores are three pairs, 6/7, 7/8, 8/9. They are minute on the right side but larger on the left. The areas surrounding the pores on the left are swollen as transversely ellipsoidal mounds extending to the setal rings. No genital markings were seen.

Internal Characters. Septa 5/6-7/8 and 10/11-13/14 are thickened, septa 8/9 and 9/10 are represented by ventral rudiments only; in 8/9 extending laterally only to the spermathecae. The gizzard is somewhat bell-shaped (Fig. 2 *a*) with the anterior diameter only slightly less than the posterior. The intestinal caeca are simple extending anteriorly from *xxvii* to *xxiii* where they flex ventrally into *xxii*. The caeca are almost imperceptibly constricted by the septa through which they pass but the constrictions are more evident at 22/23. The intestine begins in *xv*. Lateral hearts are present in *ix-xiii* passing into the ventral vessel. The right heart in *ix* is rudimentary, its diameter being about one-quarter of the left heart. A single median testis sac is present in both *x* and *xi*; laterally each sac curves gently anteriorly, the antero-lateral margins being bilobed. The seminal vesicles are fairly well developed in *xi* and *xii* being about the same height as the oesophagus. They are a somewhat depressed heart-shape each with a small ampulla arising from the dorsal cleft. The ampullae are of a slightly finer texture and in size each is about one-quarter of that of the seminal vesicle from which it arises. The prostates extend from *xvi-xxi*, they comprise two closely associated anterior and posterior groups of three lobes, each lobe itself being lobulated. As usual the paired prostatic ducts are situated in *xviii*, each forms a single loop with the ental end lying immediately dorsal to the ectal end above the copulatory chamber. The dorsal (coelomic) surfaces of the paired copulatory chambers are smooth and penial setae are apparently absent from inside. Anterior to each copulatory chamber there is an ovoid mass consisting of three small stalked glands which pass into the anterior wall of the chamber, posterior to the chamber is a smaller mass containing one stalked gland which passes into the posterior wall. The spermathecae are paired and lie in segments *vii*, *viii*, *ix*. Each is flattened and leaf-like, the length of the duct is about equal to the length of the main body. The diverticulum arises from midway along the mesial surface of the spermathecal duct, it consists of a narrow stalk reaching to nearly the equator of the spermatheca where it becomes slightly convoluted, the loops which remain in the same plane are contained by connective tissue (Fig. 1 *a*). Where the spermathecal duct passes into the parietes two small stalked glands enter into the duct, one into the anterior surface the other into the posterior surface.

Remarks. This species is the only Indian *Pheretima* with spermathecal pores in intersegmental furrows 6/7, 7/8, 8/9 and possessing both an anterior and a posterior stalked gland arising towards the ectal end of each spermathecal duct (see *Remarks* under *P. houlleti* below, and Gates, 1937 : 197, for other characters). Gates (1931 : 435) separated the subspecies *penetralis* on a series from near Darjeeling in which he found that on the posterior face of each copulatory chamber there were two ovoid glandular masses instead of the usual one; also the seminal vesicle in *xi* curled upwards and around to cover the dorsal blood vessel (this latter difference could be due to age or season, see *P. houlleti* below). These characters were not seen in the specimen reported here which resembles the Siamese subspecies *meridiana* Gates (1932 : 457) in lacking penial setae inside the copulatory chambers. In view of these discrepancies in subspecific characters and the fact that I have only one specimen before me, I do not propose to identify it subspecifically.

Pheretima diffringens (Baird)

Megascolex diffringens Baird, 1869, *Proc. zool. Soc. London*, 1869, p. 40. Plas Machynlleth, Montgomeryshire, Great Britain.

Under a damp stone in forest, Maewa Khola, Sanghu, 6500 ft. 29 October, 1961. K. H. Hyatt. 1 clitellate specimen.

Under a rock by a river, (very active when exposed to light), Maewa Khola, Sanghu, 5500 ft. 12 November, 1961. K. H. Hyatt. 1 clitellate specimen.

Under a rock by a river, Maewa Khola, Sanghu, 5500 ft. 15 November, 1961. K. H. Hyatt. 1 clitellate specimen.

On the banks of a stream after heavy rain, Maewa Khola, Sanghu, 6500 ft. 2 March, 1962. W. G. Inglis. 69 specimens.

External Characters. Gates (1931 : 387; 1936 : 412; 1937 : 198) gave details of variation in the external characters of this fairly well-known species. In the present series differences in the external anatomy are well within the limits which Gates recorded. It is interesting to note that these worms agree with his series from near Kathmandu and differ from most from elsewhere in that the clitellum extends beyond intersegmental furrows 13/14 to 16/17. It begins in the posterior quarter of *xiii*, midway between the setal ring and furrow 13/14, and finishes in the anterior quarter of *xviii*, midway between furrow 16/17 and the setal ring; the furrows being almost obliterated by the clitellum. The same agreement is not to be found, however, in the genital markings. In the Sanghu specimens there are the usual paired presetal genital markings on *vii, viii, ix* at *cd* but the larger worms have small, paired postsetal genital markings on *vi, vii, viii* abutting on the anterior or antero-dorsal borders of the spermathecal pores, also on *v* (eight specimens).

Internal Characters. (Three specimens dissected.) Septa 5/6-7/8, 10/11, 11/12 are thickened also 12/13 to a lesser extent; septa 8/9, 9/10 are missing. The gizzard is somewhat barrel-shaped but the diameter of the anterior end is less than that of the posterior (Fig. 2 *c*). The intestinal caeca arise in *xxvi* and pass forwards as far *as xxiii*, they are simple and only slightly constricted by the septa. Paired lateral hearts are present in *xi, xii, xiii*, passing into the ventral vessel. The testes sacs in *x* are joined medially and are almost dumb-bell shaped with the contents aggregated laterally. There is only one median sac in *xi*, resulting probably from fusion similar to that in *x* but it is more complete and the contents are more uniformly distributed. The seminal vesicles are paired in *xi* and *xii*, each is bilobular with a large ampulla arising from the dorsal cleft between the lobes, each ampulla is at least half of the size of one lobe. The prostates are variable differing in size from two fragile flattened lobes of the same width as the duct to massive, rather globular glands extending from *xvi* to *xix*. The right prostate of one specimen is well developed whereas the left, both gland and duct, are rudimentary. The prostatic duct forms a simple loop, like a closed U, with the open side directed postero-laterally. The spermathecae are paired and lie in segments *vi, vii, viii, ix*. Each is a slightly compressed cone slightly longer than the duct. The diverticulum arises from the antero-mesial surface of the spermathecal duct near where it passes into the parietes. It is directed posteriorly either curving gently or with a sharp flexure near its site of origin (Fig. 1 *c*). The ampulla is ellipsoidal and pure white in colour in contrast to the creamy colour of the diverticulum and spermathecal duct of these alcohol preserved specimens.

Pheretima houlleti (Perrier)

Perichaeta houlleti Perrier, 1872, *N. Arch. Mus. Paris* 8, p. 99. Calcutta.

From soil in banks of river terrace, Maewa Khola, Sanghu, 6500 ft. 18 November, 1961. K. H. Hyatt. 2 clitellate specimens.

External Characters. Length 64, 65 mm. Diameter 3 mm. Number of segments 62, 75. The colour of one specimen is a greyish brown, the other is a greenish grey-brown; both are preserved in alcohol. The first dorsal pore occurs in intersegmental furrow 10/11. The clitellum extends over *xiv, xv, xvi*, in one specimen to ⅓*xvii*. The setal rings are raised on the ventral surface in the pre-clitellar region giving a triannulate appearance. Posteriorly, the setal areas in the last seven or so segments are considerably raised. Setae are present throughout the clitellum.

Number of setae

vii[1]	*viii*[1]	*xviii*[2]	*xx*
11	18	9	51
12	17	9	52

The spermathecal pores are minute in furrows 6/7, 7/8, 8/9. The paired male pores are situated ⅓ circumference apart in *xviii* where they may be seen as indistinctly paler coloured areas in the setal ring. The single median female in *xiv* is situated anteriorly to the setal ring at a distance equal to *ab*. The pore is in the centre of a small papilla surrounded by a paler coloured area.

Internal Characters. Septa 5/6-7/8, 10/11-12/13 thickened. Septum 8/9 is rudimentary and is represented only ventrally as a narrow strip, septum 9/10 is thin and appears to be applied peripherally to 10/11. The gizzard is rather pitcher-shaped with the anterior diameter considerably less than the posterior (Fig. 2 *b*). The intestine begins in *xv*. The paired intestinal caeca are simple, they arise in *xxvii* and extend forwards only to *xxiv*. They are constricted where they pass through the septa, the constriction at 24/25 is particularly marked and the distal end of each caecum is devoid of gut content and appears as a semi-transparent ampulla. The lateral hearts pass into the ventral vessel, the last pair being in *xiii*. In one specimen the right heart in *xi* and the left heart in *xii* are rudimentary. The testes sacs are joined ventrally in both *x* and *xi* but their contents are concentrated laterally and each pair appears to be dumb-bell shaped, they are somewhat transparent but laterally they are whiter and more opaque. One specimen has a pair of small vertical seminal vesicles in *xi* and *xii*, each individual vesicle being surmounted by a primary ampulla of similar diameter. The other specimen which is sexually riper, has a pair of large seminal vesicles in *xi* each with a mid-dorsal cleft from which a small primary ampulla extends (the ampullae are the same size as those of the first specimen but the seminal vesicles are much larger). The seminal vesicles in *xii* unite dorsally above the dorsal blood vessel and the ampullae were not seen. The prostates extend from *xvii-xx* in one specimen and *xvii*-½*xix* in the other; in both they consist of several slightly depressed lobes. Each prostatic duct forms a simple loop like a constricted U and lies on the dorsal (coelomic) surface of the copulatory chamber with the open end of the U directed mesially. On the anterior wall of each copulatory chamber there are two stalked glands and on the posterior wall one. The surface of each copulatory chamber is smooth indicating the absence of setae from within. The spermathecae are paired in *vii, viii, ix*. They are variable in shape, the first pair are rounded sacs about half the size of the last pair which are more leaf-like; all are distally transparent. The spermathecae and their ducts are about equal in length, the duct being flexed through nearly 180° where it issues from the spermatheca. The diverticulum arises from the antero-mesial surface of the spermathecal duct at one-third of the distance from the ectal end. The duct is convoluted with five or six folds lying in the same plane and its diameter gradually increasing entally to swell finally into a small ampulla (Fig. 1 *b*). The total area of the convoluted diverticulum is nearly equal to two-thirds of that of the spermatheca. A small stalked gland is closely associated with each diverticulum, its fine duct passes forwards to join the antero-mesial surface of the spermathecal duct as the latter passes into the parietes.

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[1] Between the spermathecal pores

[2] Between the male pores

Remarks. For many years *P. campanulata* was confused with this species until Gates (1932 : 462) recognized the taxonomic importance of the stalked glands of the spermathecae and of the copulatory chambers as means of distinguishing between the two taxa. The spermathecal ducts of *P. campanulata* have both anterior and posterior stalked glands compared with only an anterior gland in *P. houlleti*; further, there are three stalked glands on the anterior walls of the copulatory chambers of *P. campanulata* compared with two in *P. houlleti*. Gates examined longer series than reported here and referred to other specific characters. In the Sanghu material of *houlleti* and *campanulata* additional interspecific differences are readily evident. The gizzard of *houlleti* is pitcher-shaped whereas the gizzard of *campanulata* is bell-shaped, also the spermathecal diverticulum of *houlleti* has five or six large loops in contrast to the diverticulum of *campanulata* which has only two small loops (Fig. 2).

Perionyx foveatus Stephenson

Perionyx foveatus Stephenson, 1914, *Rec. Indian Mus.* 8, p. 396. Rotung, Abor Country, eastern Himalayas.

Under a stone by a river, Maewa Khola, Sanghu, 6500 ft. 23 October, 1961. K. H. Hyatt. 1 aclitellate specimen.

On vegetation beside a river, Maewa Khola, Sanghu, 5500 ft. 12 November, 1961. K. H. Hyatt. 1 aclitellate specimen.

On the banks of a stream, Maewa Khola, Sanghu, 6500 ft. 2 March, 1962. W. G. Inglis. 1 clitellate specimen.

External Characters (Clitellate specimen). Length 56 mm. Diameter 2 mm. anteriorly, tapering to 1 mm. posteriorly. Number of segments 138. The ventral surface of the worm is slightly concave along most of its length. The specimen is preserved in alcohol, dorsally it is a uniform dark purple, ventrally a light straw colour; apart from a median ventral, oval brownish area, the clitellum is paler. The first dorsal pore is in intersegmental furrow 4/5. The prostomium is $\frac{1}{4}$ epilobous and closed posteriorly; furrow 1/2 is missing so that the first apparent segment, i.e. *i* and *ii*, seems to be conical and twice the length of other anterior segments. The clitellum is annular and extends from midway between the setal ring in *xiii* and furrow 13/14 to slightly posterior to furrow 16/17. The setal rings are closed ventrally but dorsally $zz = 1\frac{1}{2}zy$, the number of setae at *x* being 52; penial setae are absent. The female pores are closely paired immediately posterior to furrow 13/14. The male pores are paired and situated in a narrow transverse pit in *xviii*. A single, median tuberculum pubertatis is present on the ventral surface of *xvii*. The spermathecal pores are small circular papillae in furrows 6/7, 7/8, 8/9, they are closely paired each being about one-third of the distance from the lateral margin of the ventral surface to the mid-ventral line.

Internal Characters. The first septum is 5/6, no septa are thickened. The gizzard is absent but the intestine is slightly swollen in *ix*, *x*, $\frac{1}{2}$*xi*. The last lateral hearts are in *xiii*. The ovaries are in *xiii*, the funnels small and circular. The testes in *x* and *xi* are free on the posterior wall of septa 9/10 and 10/11; large, transversely situated fimbriated funnels lie freely in *x* and *xi*, they have oval apertures with the length equal to twice the width. The seminal vesicles in *xi* and *xii* extend dorsally and around the dorsal blood vessel to meet mesially. The prostates are paired, they are large in *xvii* and small in *xviii*. A short prostatic duct leads from the hilus of each gland with only slight convolutions. Paired spermathecae present in *vii, viii, ix* of varying size. the series on the right is larger, the largest spermatheca is the right in *viii*. The spermathecal ducts are rounded and half the diameter of the glands. At the ental end of each spermathecal duct there is a rudimentary diverticulum represented by a minute protuberance (Fig. 1 *d*). The excretory system is meganephridial, the nephridia which lack terminal reservoirs. 'end-bladders', are arranged in a single row along each side.

Remarks. The specimens collected at Sanghu appear to be the first recorded since Stephenson described the species nearly fifty years ago. *P. foveatus* approaches the description of *P. hingstoni* Stephenson, 1925, but among other characters it would seem to be a more slender worm tapering from the clitellum to the posterior end with a concave ventral surface which is markedly different to the convex ventral surface of the stouter *hingstoni*, moreover the female pores are more closely paired in *foveatus*. Internally, the prostates of *hingstoni* are more reniform and the prostatic ducts longer. The Sanghu specimens of *foveatus* differ from the original description in the spermathecal pores being somewhat more closely paired and the presence of dorsal pores. The position of the former were described in relation to the lateral margins of the ventral surface which may vary either in life or according to the method of killing, while dorsal pores are difficult to see even in the well-relaxed specimen reported here, so they may have been overlooked previously.

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Critical Notes on the Orchidaceae of Bombay State

XI. SOME OF THE SMALLER GENERA

BY

H. SANTAPAU, S.J., F.N.I., AND Z. KAPADIA, Ph.D.

(*With two plates*)

[*Continued from Vol.* **59** (3) : 842]

23. *SARCANTHUS* Lindl.

SARCANTHUS Lindl. Coll. Bot. t. 39 B, 1825, et Gen. Sp. Orch. 233, 1833 ; Endl. Gen. Pl. 206, 1837 ; Benth. & Hook. f. Gen. Pl. 3 : 580, 1883 ; Pfitz. in Engl. & Prantl, Pflanzenf. 2 (6) : 212, 1889 ; Hook. f. Fl. Brit. Ind. 6 : 66, 1890 ; King & Pantl. in Ann. R. Bot. Gard. Calcutta 8 : 239, 1898 ; Duthie, ibid. 9 (2) : 149, 1906 ; J. J. Smith, Fl. Buitenz. 6 : 595, 1905 ; Schltr. Orchid. 577, 1927 ; Holttum, Rev. Fl. Malaya 1 : 645, 1953.

The generic name *Sarcanthus* is derived from the Greek words *sarks* = flesh, *anthos* = flower, referring to the very fleshy flowers in most of the species.

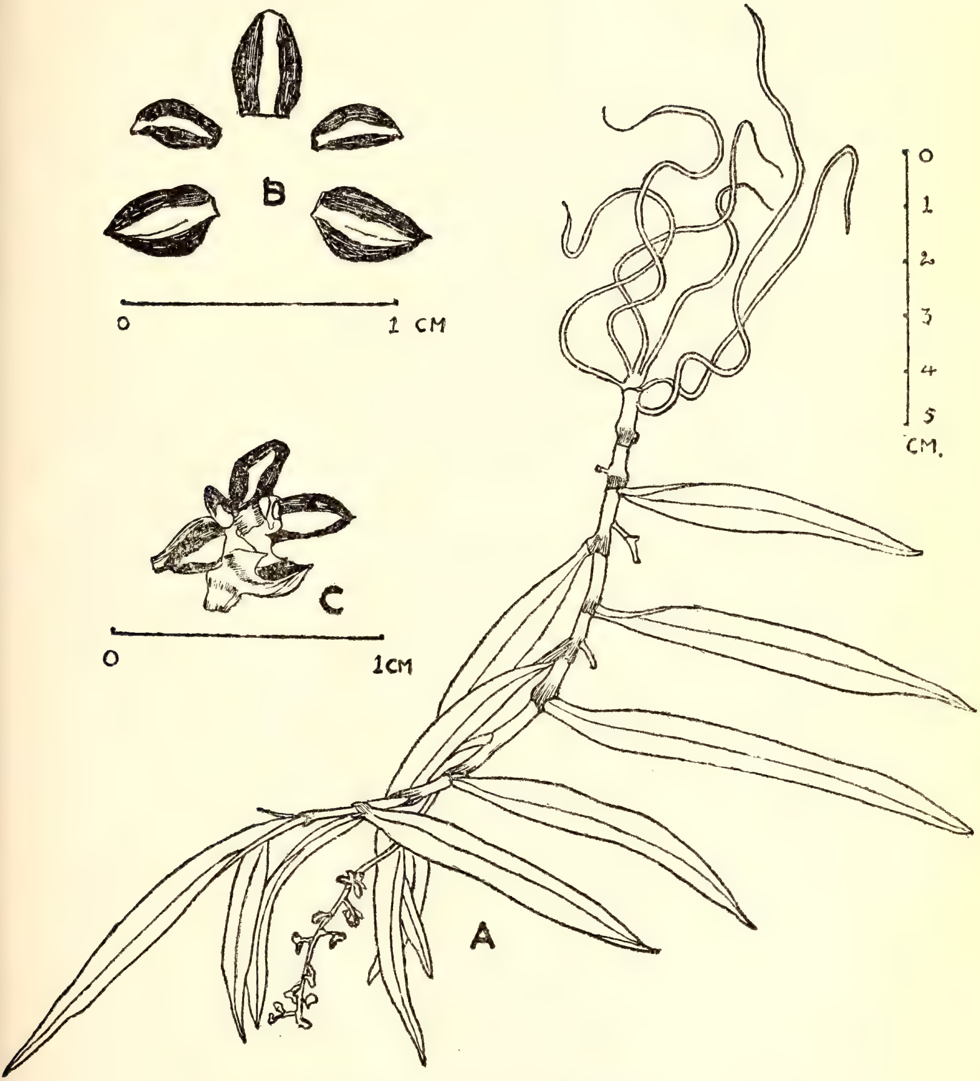
This genus contains over 70 species, occurring in Ceylon, India, Burma, Malaya, Sumatra, Java, S. China and New Guinea.

The date for *Sarcanthus* is usually given as 1821. But according to van Steenis (in *Fl. Males.* I, 4 (5) : CXCVII, 1954) the part of Lindley's *Coll. Bot.* containing *Sarcanthus* was not published before 1825.

The only species described by Lindley, when he erected the genus *Sarcanthus* in 1825, was *S. rostratus* ; this, therefore, must be considered to be the type species.

Type species : *S. rostratus* Lindl.

Sarcanthus peninsularis Dalz. in Hook. Kew Journ. Bot. 3 : 343, 1851 ; Lindl. in Journ. Linn. Soc. 3 : 39, 1858 ; Dalz. & Gibs. Bomb. Fl. 264, 1861 ; Hook. f. 67 ; Cooke, Fl. Pres. Bomb. 2 : 706, 1907 ; Gammie in Journ. Bombay nat. Hist. Soc. 20 : 128, 1910 ; Blatt. & McC. ibid. 35 : 495, 1932 ; Fischer, Fl. Pres. Madr. 1447, 1928. *Sarcanthus pauciflorus* Wight, Icon. 5 (1) : 20, t. 1747, 1851. (See Plate LIII.)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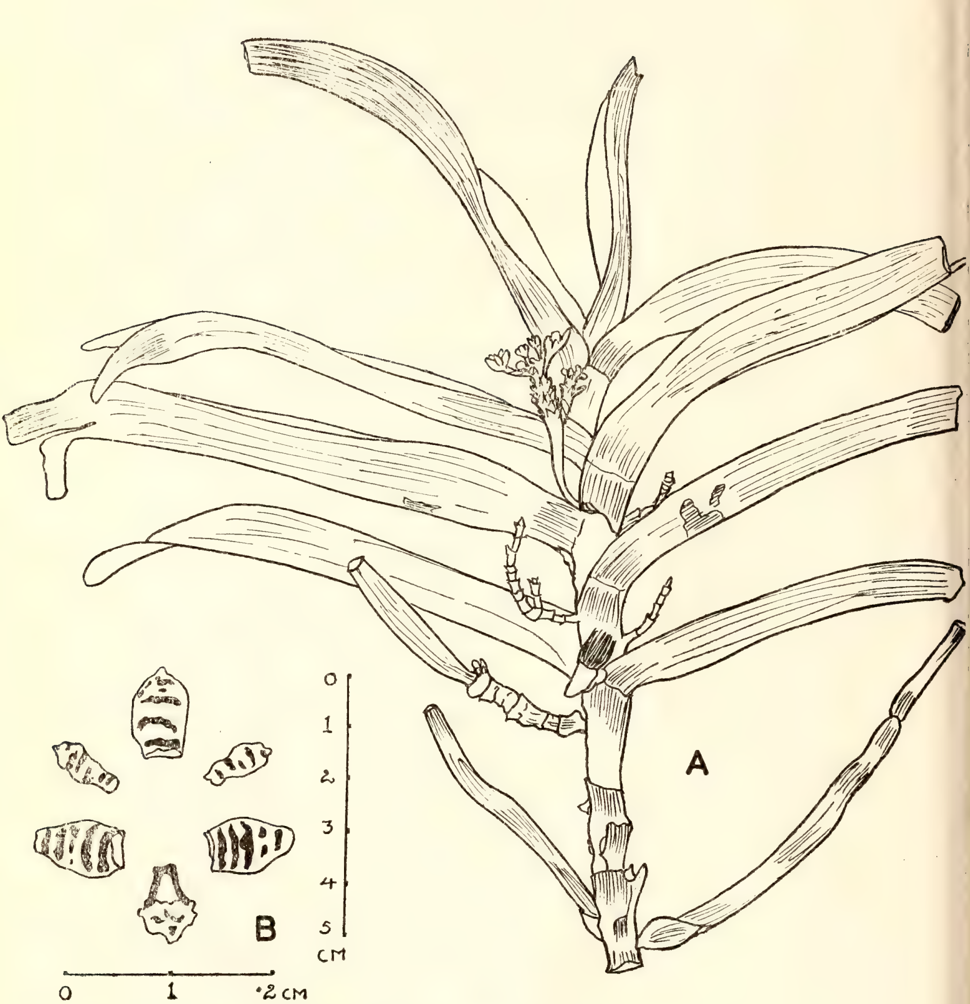
Sarcanthus peninsularis Dalz.

A. Whole plant. B. Sepals and petals dissected. C. Side view of flower.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Acampe praemorsa Blatt. & McC.

A. Whole plant. B. Sepals and petals dissected.

Pendulous *epiphytes. Stem* pendulous, dirty-green ; internodes about 1 cm. long, 3-5 mm. thick. *Leaves* 6-14 × 0.7-1 cm., thick, coriaceous, narrowly linear-oblong, somewhat acuminate, ± constricted about 1.5-2 cm. from the sharp apex. *Racemes* pointing downwards, usually arising opposite a leaf, simple, about 2-8 cm. long. *Flowers* about 7 × 7 mm., reddish-yellow, bracteate, shortly pedicellate. *Pedicel* with ovary about 2-3 mm. long, pale yellowish. *Bracts* 1.5 × 1 mm., minute, scarious, persistent, oblong, subacuminate. *Sepals* 4 × 2.5 mm., spreading, very fleshy, yellow with 2 broad brown-red bands along the margins, broadly oblong, entire, glabrous ; dorsal sepal obtuse ; lateral ones somewhat oblique, acute. *Petals* 3 × 1.5-1.75 mm., of the same colour as the sepals, very fleshy, oblong, subfalcate, acute, entire, glabrous. *Lip* 2.5 × 2 mm., 3-lobed, produced backwards and downwards into the spur ; lateral lobes erect, triangular, acute, minute, pale violet ; midlobe somewhat incurved, subacute, fleshy, arrow-head-like, with 2 yellow rounded calli in between the lateral lobes. *Spur* 2.5 × 1.5 mm. conical, obtuse, yellow, with a longitudinal septum from the mouth of the spur, ending in a rounded central callus in between the lateral calli of the midlobe. *Column* about 1.5 mm. long, stout, pale yellowish. *Anther* 2 × 1.5 mm. oblong with the anterior lip truncate and somewhat extended : pollinia 4, in pairs, globular with a narrow caudicle and a small gland. *Capsules* 17-19 × 6-8 mm. narrowly oblong, almost sessile, strongly ribbed.

Flowering : June. *Fruiting :* November.

Occurrence in Bombay State : KONKAN : *Stocks* ; Wari Country, *Dalzell.* N. KANARA : Kalanaddi, *Ritchie* ; Arbail Ghat, *Sedgwick* ; Anshi, *Bell* ; Yellapur, *Bell* 7870, *Blatt. Herb.* 233.17 (coll. *Bell*), *Kapadia* 1974-1979 ; Sirsi, *Santapau* 18640 ; Siddhapur, *Kapadia* 2365-2369 ; Jog, *Kapadia* 1775, 1777 (coll. *Bole*).

Distribution : India : Konkan, N. Kanara, W. Ghats of South India, Travancore. *World :* India, Ceylon.

24. *ACAMPE* Lindl.

ACAMPE Lindl. Fol. Orch. 1853 ; Benth. & Hook. f. Gen. Pl. 3 : 579, 1883 ; Pfitz. in Engl. & Prantl, Pflanzenf. 2 (6) : 213, 1889 ; Schltr. Orchid. 578, 1927 ; Holttum, Rev. Fl. Malaya 1 : 620, 1953. *Saccolabium* sect. *Acampe* Hook. f. Fl. Brit. Ind. 6 : 62, 1890. *Saccolabium* King & Pantl. in Ann. R. Bot. Gard. Calcutta 8 : 217, 1898 ; Duthie, ibid. 9 (2) : 136, 1906 ; (partim, non Blume 1825).

The generic name *Acampe* is derived from the Greek *akampes* = rigid, alluding to the brittle, rigid flowers of the species.

A small genus with but a few species, distributed mostly from India, Burma, to Southern China; it is also represented in Africa and Madagascar.

According to Lindley, this genus is distinguished from *Vanda* R. Br. by its small, brittle, inflexible flowers; by the lip, which is adnate to the edges of the column; and by their slender caudicles with a very small gland; it forms a very natural group. Holttum, however, has pointed out that the genus *Acampe* Lindl. has not been dealt with by those who have rearranged the orchids of the *Sarcanthus* group in recent years, and that the limits of the genus are not yet certain.

KEY TO THE SPECIES OF *ACAMPE* OF BOMBAY

Inflorescence much shorter than the leaves, up to 8 cm. long, in dense corymbose racemes; spur a small conical sac .. *praemorsa*
Inflorescence much longer than the leaves, up to 20 cm. or more long, laxly panicled; spur about 3-4 cm. long, oblong .. *ochracea*

Acampe praemorsa (Roxb.) Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35 : 495, 1932. *Epidendrum praemorsum* Roxb. Pl. Corom. 1 : 34, t. 43, 1795. *Cymbidium praemorsum* Swartz in Nov. Act. Upsal. 6 : 75, 1799; Roxb. Fl. Ind. 3 : 465, 1832; *Aërides praemorsum* Graham, Cat. Bomb. Pl. 204, 1839, (non Willd. 1805). *Saccolabium papillosum* Dalz. & Gibs. Bomb. Fl. 264, 1861 (non Lindl. 1832 nec Bot. Reg. t. 1552). *S. praemorsum* (Roxb.) Hook. f. Fl. Brit. Ind. 6 : 62, 1890; Prain, Beng. Pl. 1022, 1903; Haines, Bot. Bih. Or. 1180, 1924. *Acampe wightiana* Lindl. Fol. Orch. Acampe 2, 1853; Cooke, Fl. Pres. Bomb. 2 : 705, 1907; Fischer, Fl. Pres. Madr. 1447, 1928; Thwaites, Enum. Pl. Zeyl. 303, 1864. *Vanda wightiana* Lindl. ex Wight, Icon. 5(1) : 9, t. 1670, 1851. *Saccolabium wightianum* Hook. f. Fl. Brit. Ind. 6 : 62, 1890; Grant, Orch. Burma 286, 1895; Gammie in Journ. Bombay nat. Hist. Soc. 20 : 126, t. 10, 1910. (See plate LIV.)

Epiphytes. *Stem* about 1-1.5 cm. thick, sheathed; sheaths brown, woody, longitudinally striated. *Leaves* thick, coriaceous, channelled, 12-30 × 1.5-3 cm., oblong, entire, emarginate with 2 unequal rounded lobes. *Peduncle* 1.5 -6 cm. long, rarely branched; racemes compact, corymbose. *Flowers* clustered at the apex of the peduncle, pedicellate, bracteate. *Bracts* minute, ovate-oblong, acute, persistent, brown. *Sepals* 8 × 5 mm. similar, coriaceous, entire, creamy-yellow with dark brownish-red irregular transverse bands; lateral sepals ovate, obtuse, rarely subretuse; dorsal sepal obovate-oblong, obtuse, mucronulate. *Lip* 7.5 mm. long, 5 mm. broad when spread out, creamy-yellow with 3-4 small narrow, red lines arranged in the form of a cross on the broad midlobe; fleshy, saccate at the base, obscurely 3-lobed ; lateral lobes small, erect, subentire ; midlobe dilated beyond the lateral lobes, deflexed, obovate-suborbicular, acute or mucronulate, margin irregularly waved. *Column* 3 × 3 mm. short, stout, with 2 erect, minute horns produced on top from the sides of the column ; broadly margined with deep brownish-red. *Anther* 2×2 mm. triangular-conical ; pollinia 2, waxy, yellow, globose, with a narrow, linear-oblong, translucent caudicle and a small, oblong gland. *Stigmatic surface* broadly oblong, large, margined with brownish-red. *Ovary* with *pedicel* 1 × 0.4 cm. yellow, twisted. *Capsules* 6-7 × 0.6-0.8 cm. cigar-shaped, longitudinally ribbed.

Flowering : April to August. *Fruiting :* May onwards.

Occurrence in Bombay State : KONKAN : Kanheri, *Gammie* ; Thana, *Ryan* ; Bhandup, *Blatter*; *Kapadia* 1504; Kondita (Salsette), *Blatter* ; Sion, *Blatter* ; Indapur, *Graham* ; Vehar, *Santapau* 11197 ; *Kapadia* 489 ; Andheri, *Santapau* 10015-10018 ; Borivli. *R. Fernandez* 77 ; *Herbert* 1615 ; Ghodbunder, *Kapadia* 1111, 1119-1120 ; Bassein, *Santapau* 10077 ; Mumbra, *Shenoy* 2437, 3490 ; Badlapur, *Kapadia* 1945. N. KANARA : Belgaum, *Ritchie* ; Devicop, *Sedgwick* ; Dandeli, *Sedgwick* 2546 ; *Kapadia* 2036 ; Ankola-Belikeri, *Kapadia* 2175 ; Kumbelli Mines, *Kapadia.*

Distribution : India : Bengal, Chota Nagpur, Konkan, W. Ghats of Bombay and south peninsular India, Godavari District, N. Kanara. *World :* India, Burma and Ceylon.

Notes : This is one of the commonest and most abundant orchids in Bombay State. It is usually found in masses epiphytic on *Mangifera indica* L., *Syzygium* sp., *Terminalia* sp.

Acampe ochracea (Lindl.) Hochr. in Bull. N. Y. Bot. Gard. 6 : 270, 1910. *Saccolabium ochraceum* Lindl. in Bot. Reg. misc. 2, 1842; Hook, f. 62 ; Grant 285 ; Brühl, Guide Orch. Sikk. 131. *S. lineolatum* Thwaites, Enum. Pl. Zeyl. 304, 1864. *Acampe wightiana* Lindl. var. *longepedunculata* Thwaites, Enum. Pl. Zeyl. 303, 1864.

Erect or pendulous *epiphytes*. *Leaves* coriaceous, sheathing at the base, 8.5-20 × 0.6-2 cm., narrowly oblong, entire, shallowly and unequally 2-lobulate at the apex. *Inflorescence* 8-20 cm. long ; panicles lax, branching, longer or shorter than the leaves ; peduncles terete, bracteate at the nodes. *Flowers* pedicelled, bracteate. *Bracts* minute, scarious, brown. *Sepals* and *petals* 6 × 2 mm., similar, yellow with pale red transverse markings, fleshy, obovate-oblong, obtuse, the lateral sepals subacute, entire, faintly 3-nerved. *Lip* 3.5 × 3 mm., 3-lobed, pale pinkish-white ; lateral lobes erect, small, 2 mm. broad, irregularly toothed ; midlobe obovate-triangular, irregularly serrulate, acute. *Spur* 3-4 mm. long, oblong, subclavate, obtuse, parallel to the ovary, with 2 longitudinal septa within. *Column* small, with 2 erect, anterior horns; clinandrium with a central elevated boss. *Anther* 1 × 1.5 mm., transversely oblong-orbicular; pollinia 2-cleft, globular with a caudicle 1 mm. long and narrow linear, and a gland minute and transversely oblong. *Stigmatic surface* deeply seated within, below the projecting bosses of the rostellum. *Ovary* with *pedicel* 7.5 mm. long, oblong columnar, faintly ribbed. *Capsules* with stalk 3.5 × 0.7 cm., linear-oblong, faintly ribbed.

Flowering : December. *Fruiting :* May.

Occurrence in Bombay State : N. KANARA : Yellapur, *Kapadia* 1770, 2862 ; Sirsi—Siddhapur, *Kapadia* 2445.

Distribution : India : Sikkim, Khasia Hills, N. Kanara. *World :* India, Burma and Ceylon.

Notes : This species has not been found previously in Bombay State. It constitutes a new record for this area.

25. *DIPLOCENTRUM* Lindl.

DIPLOCENTRUM Lindl. in Bot. Reg. sub t. 1522, 1832, et Gen. Sp. Orch. 218, 1833 ; Endl. Gen. Pl. 204, 1837 ; Benth. & Hook. f. Gen. Pl. 3 : 582, 1883 ; Pfitz. in Engl. & Prantl, Pflanzenf. 2(6) : 209, 1889 ; Hook. f. Fl. Brit. Ind. 6 : 78, 1890 ; Schltr. Orchid. 580, 1927.

The generic name *Diplocentrum* is derived from the Greek words *diplos* = double, and *kentron* = a sharp point, a spur, in allusion to the 2 collateral spurs found in the species.

This genus contains 2 species restricted to south peninsular India.

Type species : *D. recurvum* Lindl.

Diplocentrum congestum Wight, Icon. 5(1) : 10, t. 1688, 1851 ; Hook. f. 78 ; Rolfe in Hook. Icon. Pl. 27 : t. 2687, 1901 ; Cooke, Fl. Pres. Bomb. 2 : 704, 1907 ; Gammie in Journ. Bombay nat. Hist. Soc. 20 : 129, 1910 ; Blatt. & McC. ibid. 35 : 497, 1932 ; Fischer, Fl. Pres. Madr. 1449, 1928.

Small *epiphytes*. *Stem* very short, sheathed. *Leaves* 2-4, coriaceous, somewhat channelled, recurved, 2-7 × 0.5-0.8 cm., narrowly linear-oblong, unequally and obtusely bilobed at the apex, green mottled with purple. *Racemes* up to 9 cm. long, arising from much below the leaves just a little above the roots, few- to many-flowered ; peduncle 1-1.5 mm. thick, greenish, bracteate. *Flowers* about 5-7 mm. across, bracteate, very shortly pedicellate. *Ovary* with *pedicel* about 3 mm. long, greenish-brown, slightly curved in the apical part. *Bracts* minute, apiculate, pale brown. *Sepals* and *petals* pale green or pinkish-brown with a central deep pink streak, spreading, subobtuse, entire, glabrous ;

dorsal sepal 3 × 1 mm., narrowly elliptic-oblong. *Lip* 4-5 mm. long, white, pale pink, or pink-mauve, fleshy, somewhat reflexed and truncate at the apex, broader and produced at the base into 2 spurs which are shortly diverging, about 1 mm. long, somewhat tubercled and pale pinkish or greenish-brown. *Column* very short, white with 2 parallel, pink, somewhat kidney-shaped streaks on the sides. *Anther* 1 × 1 mm. oblong-obovoid, pale greenish-yellow or yellow, anterior lip truncate; pollinia 2, bipartite; caudicle 1.5 mm. long, apiculate, basal half ovate-oblong, about 1 mm. broad, glandular. *Capsule* 18 × 3-4 mm., broadly ovoid, slightly curved, ribbed, with a 2 mm. long pedicel.

Flowering : May. *Fruiting :* May onwards.

Occurrence in Bombay State : N. KANARA : Sirsi—Kumpta, *Woodrow* ; Castle Rock, *Blatt. Herb.* 31030 (coll. *T. R. Bell*) ; *Kapadia* 2817-2818 ; Yellapur, *Kapadia* 2870-2871.

Distribution : N. Kanara, W. Ghats of Bombay State and South India, Travancore.

Notes: We have found this species epiphytic on *Syzygium* sp. in open deciduous forest.

26. *EPIPOGIUM* R. Br.

EPIPOGIUM R. Br. Prodr. 330, 1810 ; Santapau in Proc. nat. Inst. Sci. India 24 B : 138. *Epipogum* Gmelin, Fl. Sibir. 1 : 11, t. 2, f. 2, 1747 ; Endl. Gen. Pl. 212, 1837 ; Benth. & Hook. f. Gen. Pl. 3 : 617 ; Pfitz. in Engl. & Prantl, Pflanzenf. 2 (6) : 111 ; Hook. f. Fl. Brit. India 6 : 124 ; King & Pantl. in Ann. R. Bot. Gard. Calcutta 8 : 252 ; Duthie, ibid. 9 (2) : 150 ; J. J. Smith, Fl. Buitenz. 6 : 61 : Schltr. Orchid. 100 ; Holttum, Rev. Fl. Malaya 1 : 106. *Ceratopsis* Lindl. Gen. Sp. Orchid. 383, 1835. *Podanthera* Wt. Icon. 5 (1) : 22, t. 1759, 1851.

The name *Epipogium* is derived from the Greek, *epi* = upon, and *pogon* = beard, probably with reference to the glandular hairs on the lip.

Species about 5, very widely distributed in the temperate regions of Europe and Asia.

On the spelling of the generic name, see Santapau, loc. cit.

Epipogium roseum (D. Don) Lindl. in Journ. Linn. Soc. 1 : 177, 1857 ; Holttum 106 ; Santapau loc. cit. 139. *Limodorum roseum* D. Don, Prodr. Fl. Nep. 30, Febr. 1825. *Galera rosea* Bl. Bijdr. 416, f. 3, Dec. 1825. *Epipogum nutans* Reichb. f. in Bonpland. 5 : 36, 1836 ; Lindl. 177 ; Hook. f. 124 ; King & Pantl. 252, t. 335 ; J. J. Smith 61, f. 39 ; Brühl, Guide Orch. Sikk. 148 ; Fischer 1460 ; Blatt. & McC. 35 : 729. *Podanthera pallida* Wt. Icon. 5 (1) : 22, t. 1759, 1851.

Rhizome an ovoid horizontal tuber, about 5 × 3.5 cm., with few short internodes. Scapes leafless, 10-40 cm. high, hollow, fleshy, about 1 cm. thick at base, gradually narrowing upwards, sparsely sheathed in the basal region, yellowish. *Flowers* drooping, white, pedicellate, bracteate ; pedicels about 3 mm. long, curved. *Bracts* 7-9 × 3-4 mm., shorter than the ovary. *Sepals* and *petals* 8-11 × 2-4 mm., not much spreading, narrowly linear, acute, entire, 3-nerved. *Lip* about equalling sepals and petals, concave, obovate-oblong in outline, irregularly crenulate, with the sides raised at the base, with a small blunt apiculum or without it ; upper surface minutely warted in 2 rows ; colour white with a few reddish brown spots. *Spur* short, somewhat bulbous, pointing backwards below the ovary, obtuse. *Column* very short. Anther larger than the column. Stigmatic surface at the base of the column, prominent. Ovary broadly ovoid, drooping, pale yellow, 8 × 4 mm.

Flowering : May.

Occurrence in Bombay State : N. KANARA : Yellapur, *Bell* 4068.

Distribution : Tropical Himalayas, Sikkim in hot valleys up to 1300 m., Khasia Hills up to 2000 m., southwards to N. Kanara, Coorg, Bolampati Hills at 1400 m., Anaimalais, Pulneys at 1600 m., Wynaad. *World :* W. Africa, India, Nepal, Ceylon, Malaya, Java, Australia.

ARTIFICIAL KEY TO THE GENERA OF ORCHIDACEAE IN BOMBAY STATE

1. Epiphytic or lithophytic plants :
  2. Plants with distinct pseudobulbs :
    3. Pseudobulbs flattened, discoid, rounded :
      4. Pseudobulbs with distinct reticulate, lace-like sheaths ; flowers orange or deep brown-red ; sepals united to form a tube at least at base .. *Porpax*
      4. Pseudobulbs without lace-like sheaths; flowers greenish-yellow or white ; sepals completely free .. *Eria*
    3. Pseudobulbs elongated, ovoid or conical :
      4. Pseudobulbs 2- or more-noded (rarely 1-noded in *Dendrobium* sect. *Stachyobium*) :
        5. Leaves thick, coriaceous, 20-25 cm. long ; inflorescence lateral ; lip with calli or keels at base .. *Cymbidium*
        5. Leaves thin, membranous, not exceeding 15 cm. in length ; inflorescence terminal or lateral; lip without calli or keels :
          6. Flowers spurred ; spur projecting beyond lateral sepals ; sepals and petals about 4 cm. long ; pollinia 8 .. *Thunia*

6. Flowers with a short mentum which is enclosed by lateral sepals; sepals and petals up to 2.5 cm. long ; pollinia 4 or 8 :

7. Inflorescence terminal ; lip superior ; pollinia globular with a short broad caudicle .. *Polystachya*

7. Inflorescence terminal or lateral ; lip inferior ; pollinia linear or pyriform without caudicles :

8. Pedicel and ovary sparsely pubescent ; pollinia 8, pyriform .. *Eria mysorensis*

8. Pedicel and ovary glabrous ; pollinia 4, linear or linear-oblong *Dendrobium*

4. Pseudobulbs only of a single node :

5. Pseudobulbs with 2 or more thin, membranous leaves ; leaves deciduous at time of flowering ; scape bearing a fan-shaped, radiating umbel at apex ; lateral sepals $2\frac{1}{2}$-$3\frac{1}{2}$ times as long as the dorsal .. *Cirrhopetalum*

5. Pseudobulbs with a single thick coriaceous leaf on top ; leaves persistent ; scape 1-flowered or bearing an elongated raceme ; sepals subequal :

6. Pseudobulbs 1 × 1.3-1.7 cm. shortly conical-ovoid ; leaf 1.5-4.5 cm. long ; scape 1-flowered ; anther with a long horn .. *Trias*

6. Pseudobulbs 2-8 cm. long, oblong or conical-ovoid ; leaf 4-30 cm. long ; scape many-flowered ; anther without a horn :

7. Pseudobulbs conical-ovoid, dark-green or brownish-purple with broad grooves along its length ; leaf-apex acute ; scape 20-45 cm. long .. *Pholidota*

7. Pseudobulbs oblong, yellowish-green, 3-5-angled ; leaf-apex obtuse or emarginate ; scape up to 12 cm. long *Bulbophyllum*

2. Plants without pseudobulbs :

3. Plants completely leafless, or rarely with scale leaves ; scape small, glandular-pubescent, arising directly from cluster of greenish roots .. *Chiloschista*

3. Plants with normal green leaves :

4. Plants with fleshy rhizomes ; scape pubescent ; sepals united for about half their length ; pollinia lamellate .. *Cheirostylis flabellata*

4. Plants without rhizomes ; scape glabrous ; sepals free ; pollinia waxy :

5. Leaves membranous, plicate ; lip superior *Malaxis versicolor*

5. Leaves fleshy or coriaceous, not plicate ; lip inferior :

6. Plants without a distinct stem; leaves radical:

7. Leaves sessile, fleshy, laterally compressed; flowers in terminal, dense, cylindric, simple spikes or racemes; pollinia 4, without a gland or caudicle .. *Oberonia*

7. Leaves petiolate, coriaceous, normal; flowers in lateral, laxly branching racemes; pollinia 4 with a broad gland .. *Sirhookera*

6. Plants with a distinct stem; leaves cauline:

7. Leaves terete; scape up to 2 cm. long, stout, woody .. *Luisia*

7. Leaves flat, scape longer, herbaceous:

8. Scape branched, 2-5 times as long as leaves: flowers not spurred; lip resembling a bee .. *Cottonia*

8. Scape simple or rarely branched, not more than twice as long as leaves; flowers spurred; lip not resembling a bee:

9. Spurs 2 .. *Diplocentrum*

9. Spur 1:

10. Leaf-apex acute or sharply pointed; flowers about 7 mm. across .. *Sarcanthus*

10. Leaf-apex irregularly toothed with 1-3 sharp teeth; flowers larger:

11. Flowers whitish or pale pink; lip scarcely lobed; spur laterally compressed, truncate at apex .. *Rhynchostylis*

11. Flowers variously coloured, not whitish or pale pink; lip distinctly 3-lobed; spur short oblong or conical, obtuse at apex .. *Vanda*

10. Leaf-apex bilobed, lobes unequal or subequal, rounded or subacute; flowers larger:

11. Stem very short; mid-lobe of lip semi-circular forming a brim on large ventricose, sacc-

ate spur; pollinia shorter than narrow linear caudicle, with a small linear gland .. *Gastrochilus*

11. Stem long; midlobe of lip various; spur narrow, linear or rarely a small conical sac; pollinia about equalling oblong caudicle with a small more or less oblong or square gland :

12. Sepals and petals coriaceous, yellow with unequal, horizontal, crimson bars; lip 3.5-7.5 mm. long, column without a foot .. *Acampe*

12. Sepals and petals pale pink or pinkish-mauve; lip 10-28 mm. long, column with a stout foot *Aërides*

1. Terrestrial or saprophytic, rarely epiphytic plants (see *Cheirostylis, Malaxis*) :

2. Lip spurred; spur projecting beyond lateral sepals :

3. Plants with green leaves; leaves not plicate; anther immovably affixed to column by a broad base :

4. Flowers about 7.5 cm. across, greenish-white; stigmatic surfaces flat, almost confluent .. *Platanthera*

4. Flowers not exceeding 3 cm. across, green, white or yellow; stigmatic surfaces not flat, separate :

5. Ovary and capsules ± erect and parallel to peduncle, not spreading at an angle to it; stigmatic surfaces in form of small swellings on edge of lip .. *Peristylus*

5. Ovary and capsules widely spreading at an angle to peduncle; stigmatic lobes standing out as stalked appendages .. *Habenaria*

3. Plants with green leaves or rarely saprophytes; leaves plicate, rarely absent; anther separable from the column or often attached at base by a slender filament :

4. Plants with a cluster of stout fibrous roots; lip superior .. *Tropidia*

4. Plants with a fleshy rhizome or subterranean tuberous pseudobulbs; lip inferior:

5. Flowers appearing with the leaves:

6. Leaves puberulous; spur long, slender; pollinia 8 .. *Calanthe*

6. Leaves glabrous; spur short, rounded, conical or saccate; pollinia 2:

7. Inflorescence erect; lip with a short, rounded or conical spur .. *Eulophia*

7. Inflorescence decurved; lip with a wide conical sac .. *Geodorum*

5. Leaves absent or flowers appearing after leaves:

6. Leafless saprophytes with fleshy, rounded or ellipsoid rhizomes lying horizontally on ground; pollinia 2, powdery, each with its own long, slender caudicle .. *Epipogium*

6. Leaves present appearing much before flowers; plants with fleshy, tuberous, irregularly shaped pseudobulbs; pollinia 2, waxy, attached to a short caudicle and a small gland .. *Eulophia*

2. Lip not spurred, often saccate at the base; sac never projecting beyond the lateral sepals:

3. Sepals united for about half their length:

4. Leafless, brown saprophytes; pedicels greatly elongating in fruit; limb of lip undivided *Didymoplexis*

4. Plants with green leaves; pedicels not elongating in fruit; limb of lip 2-cleft, lobes digitately fimbriate .. *Cheirostylis*

3. Sepals free:

4. Leaves and flowers not appearing together:

5. Leaves petiolate, cordate or orbicular; scape glabrous; pollinia 2, powdery, without caudicles or glands .. *Nervilia*

5. Leaves sessile, narrowly oblong-lanceolate; scape pubescent; pollinia 8, waxy, adhering to a small viscid mass .. *Pachystoma*

4. Leaves and flowers appearing together:

5. Plants with subterranean pseudobulbs; pollinia 4, waxy without caudicles, adhering in pairs to a small, viscid mass:

6. Lip inferior, without auricles; column long, winged in upper part .. *Liparis*

6. Lip superior, with or without auricles; column very short, wingless .. *Malaxis*

5. Plants with a rhizome or a cluster of fibrous roots; pollinia 2, lamellate with a caudicle and a small, orbicular gland:

6. Plants with a cluster of stout, fibrous roots ; spikes spirally twisted ; lip subsaccate at base, the apex not widened into a blade ..	*Spiranthes*
6. Plants with a short or long rhizome ; spikes not spirally twisted ; lip with a prominent convex sac at base, the apex widened into a bilobed blade ..	*Zeuxine*

(*Concluded*)

On the freshwater Molluscs of Poona

BY

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(*With one map and six plates containing thirty-six figures*)

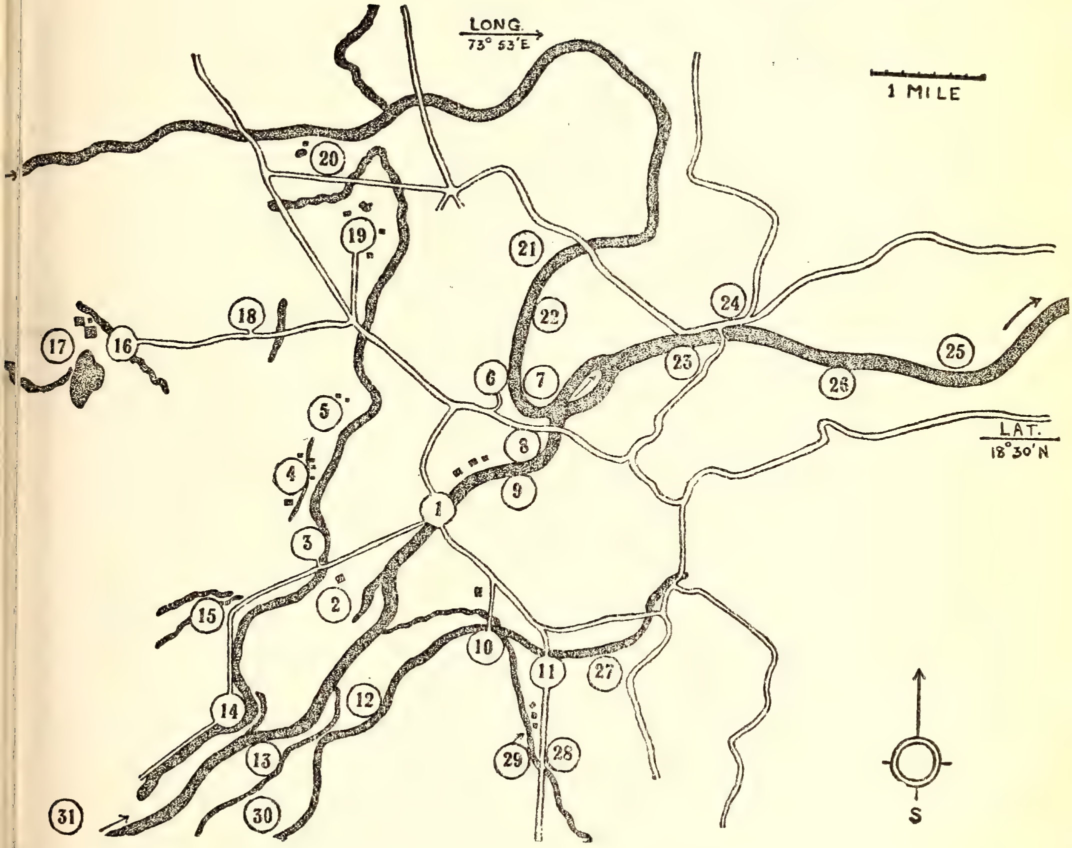
INTRODUCTION

The available information on the freshwater and amphibious Mollusca of Poona City and its neighbourhood is necessarily scanty and scattered. Some of the references are not even readily available. The volumes of the FAUNA OF BRITISH INDIA series on Mollusca, though comprehensive, provide Latin descriptions of many species and thus are of limited utility to Indian students of Mollusca. The lack of adequate illustrations of the species described has also made it difficult to understand these otherwise excellent works. Further, as has been rightly pointed out by Satyamurty (1960), the nomenclature of many species, their correct systematic position, and their true relationships with other groups have undergone serious revision during the last three decades. The few earlier records of the species available in this area are very vague in mentioning the localities and are practically devoid of any useful biological information. The present paper aims at giving a revised list of the species available in and around Poona City with brief information on their habitats. The list is provisional and is in no way complete, as the work is currently under progress and will be followed later by a full list of the species together with observations on their biology.

Satyamurty's (loc. cit.) recent contribution on the land and freshwater Mollusca in the collection of the Madras Government Museum, a most welcome addition to the literature on conchology, has proved very useful in the present work.

METHODS

Collection of the specimens was made in regular once-a-week visits to different aquatic habitats in and around Poona City. The sketch map shows the localities and area explored for this study.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ch map of Poona showing stations where collections of Freshwater Molluscs were made

. Deccan Gymkhana ; 2. Yerandawane ; 3. Left Bank Canal ; 4. Law College area ; 5. Fergusson ge area ; 6. Shivajinagar Station ; 7. Mula River near Sangam ; 8. Mutha River near Sangam ; 9. Nava ; 10. Parvati ; 11. Swargate (Right Bank canal); 12. Vithalwadi area ; 13. Vadagaon region ; 14. .T. Society ; 15. Kothrud Canal ; 16. Pashan tank ; 17. Pashan Canal ; 18. National Chemical Labo- ; 19. University of Poona ; 20. Botanical Garden ; 21. Mula River near Kirkee, South ; 22. Mula River Kirkee, East ; 23. Bund Garden area ; 24. Mula-Mutha River near Yerawada ; 25. Mula-Mutha River Yerawada, two miles East ; 26. Mula-Mutha River near Yerawada, one mile East ; 27. Right Bank near Shankarshet Road ; 28. Ambil Odha near Padmavati ; 29. Aranyeshwar Temple area ; adgaon Canal ; 31. Mutha River towards Kharakwasala.

Abbreviations

The following contractions have been used in describing the different parts and usual measurements:

L—length
H—height
D—diameter or depth
DM—diameter major
dm—diameter minor
AH—apertural height
AW—apertural width
DV—depth of the two halves

The measurements are those of single specimens of the species and do not represent averages. Average measurements are deliberately not provided in this paper; unless a long series of specimens is examined it would be meaningless to give average measurements.

The bracketed numbers indicate other localities where a given species occurs.

Systematic List of the Species

Class	GASTROPODA
S. Class	PROSOBRANCHIATA
Order	MEGAGASTROPODA
Series	ARCHITAENIOGLOSSA
Family	CYCLOPHORIDAE

1. **Cyclophorus (Litostylus) involvulus** (Müller) (Fig. 1)

The shell is turbinate and the spire is elevated with inflated whorls. The shell is spirally striated and striae on the body whorl form spiral ridges. The aperture is oblique to the axis and is circular. The peristome is thick and markedly reflected. The umbilicus is broad and deep but partially occluded by the reflected peristome. The shell is chestnut coloured with brownish white wavy marks.

Locality. Only a single intact specimen was collected, along with some broken pieces, on the bank of Mutha River near Vithalwadi. Attempts to secure more specimens have not proved successful. The species is thus rare and not available readily in this area.

Measurements. H—13 mm.; DM—26 mm.; dm—16 mm.; AH—12 mm.; AW—12 mm.

2. **Cyclophorus (Annularia) aurantiacus** (Schumacher) (Fig. 2)

The shell is quite large, thick, and solid. The spire is turbinate, more depressed and relatively broad. The last whorl is broad and the whorls of the spire are convex. All the whorls are transpirally striated but the basal part of the body whorl is smooth and fine. The conspicuously large aperture is circular and has a thickened peristome which is reflected out. The shell is fulvous white with zig-zag deep brown marks. The interior of the apertural lip is bright orange while the inner portion is whitish.

Locality. Two specimens in good condition were collected from the bank of Mutha River near Vithalwadi. The species seems to be rare and has not been noticed elsewhere.

Measurements. H—20 mm.; DM—33 mm.; dm—22 mm.; AH—16 mm.; AW—16 mm.

Family VIVIPARIDAE

S. Family VIVIPARINAE

3. **Vivipara bengalensis** (Lamarck) (Fig. 3)

This is a familiar banded pond snail formerly known as *Paludina*. Satyamurty (loc. cit.) gives good information on the various allied species.

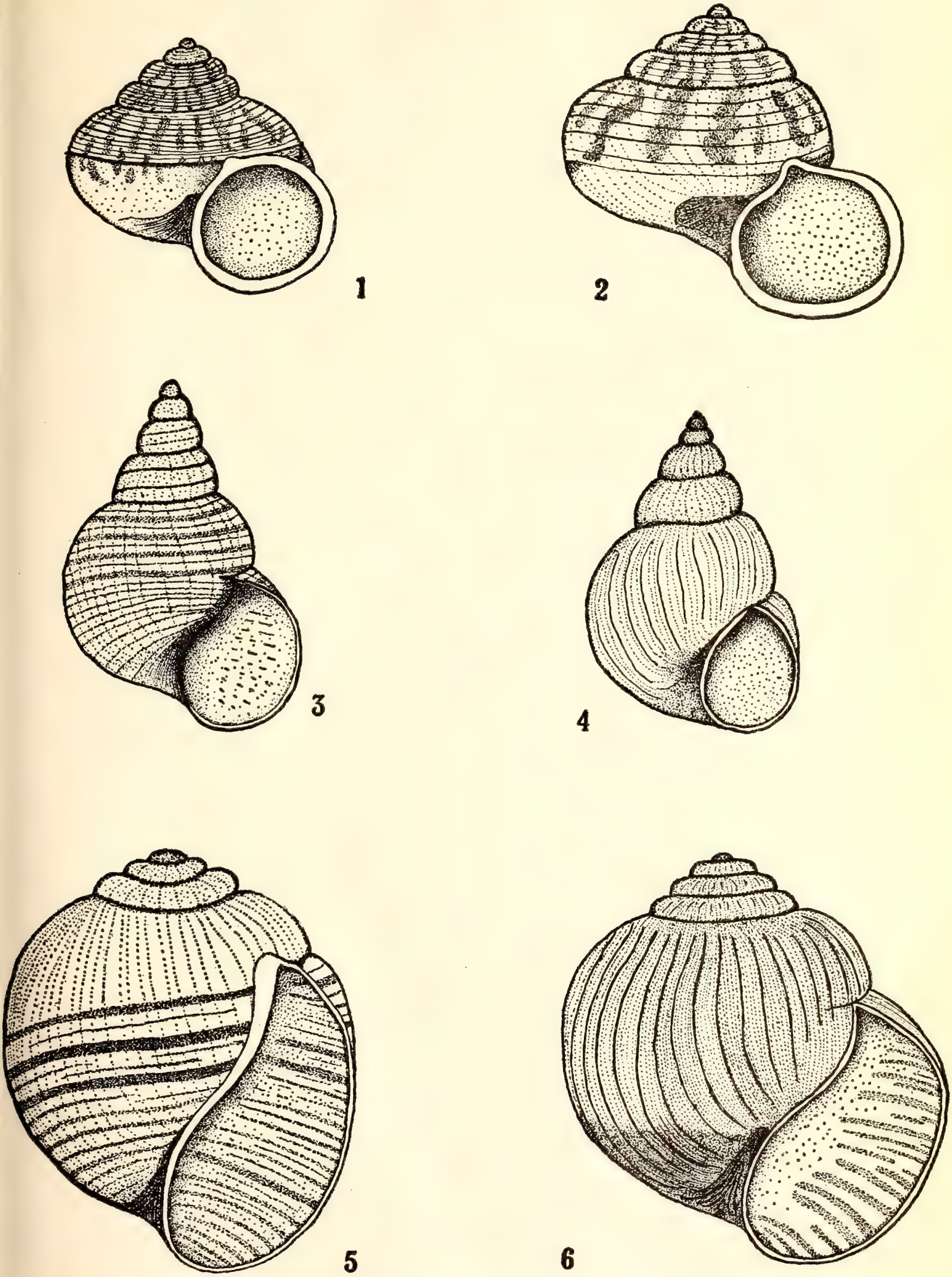
The shell is ovately conical. The lower part is more or less ovoid with a spire which is broadly conical. The whorls are rather inflated and the sutures are well impressed. The aperture is mango-shaped, i.e. angularly pointed above and rounded below. The sculpture consists of close-set fine transpiral lines and minute punctures. The coloration varies a great deal but usually the shell is olive-green with alternating broad and narrow dark brown spiral bands. The narrower bands are lighter in colour than the broad ones. The former alone are present in the basal part of the body whorl.

Locality. This species is quite common in Poona and is found in ponds and pools. The specimens were collected from all the localities; the one figured is from the ponds in Sambhaji Park. (1, 2, 4, 5, 8, 13, 16, 19, 20, 23, 25, 29).

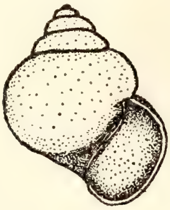
Measurements. H—25 mm.; DM—21 mm.; dm—17 mm.; AH—15 mm.; AW—11 mm.

4. **Vivipara dissimilis** (Müller) (Fig. 4)

This is also a common pond snail. It is treated by some authors as a variety of *V. bengalensis*. The shell is broader with a body whorl which is more ovoid. The sculpture consists of close-set delicate spiral striae and oblique transpiral growth striae which are prominent and well marked in the peripheral region of the body whorl. The ovoid



1. *Cyclophorus* (*Litostylus*) *involvulus* (Müller) × 0.8 ; 2. *Cyclophorus* (*Annularia*) *aurantiacus* (Schumacher) × 1 ; 3. *Vivipara bengalensis* (Lamarck) × 1.6 ; 4. *Vivipara dissimilis* (Müller) × 1.6 ; 5. *Pila globosa* (Swainson) × 1 ; 6. *Pila* sp. × 1,3



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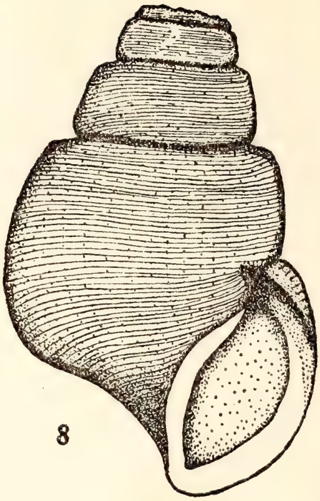

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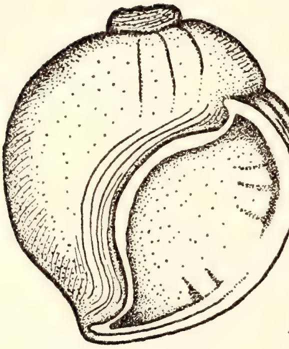

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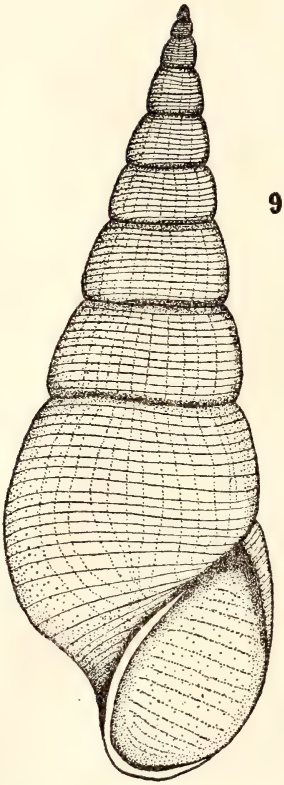

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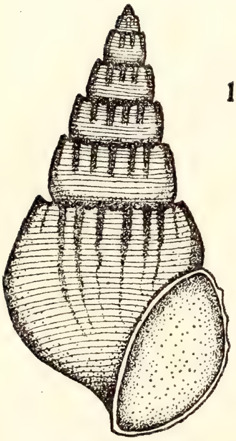

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7. *Bithynia stenothyroides* Dohrn. × 4 ; 8. *Sulcospira* (*Sulcospira*) *hügeli* var. *compacta* Nevill. × 4 ; 9. *Faunus ater* (Linné) × 2.5 ; 10. *Paludomus* (*Stomatodon*) *stomatodon* Benson × 1·8 ; 11. *Melania* (*Plotia*) *scabra* (Müller) × 2

aperture is covered by a horny operculum which is narrowed above. The umbilicus is narrower in this species than in *V. bengalensis*. The shell is dirty olive-green ; the interior is of dull bluish white colour.

Locality. Several specimens of empty dead shells of varying sizes have been collected from the Mutha River banks. They are abundantly available beyond M. E. S. College and Sambhaji Park area. Freshwater ponds often contain this species along with *V. bengalensis*, but it is of interest that the number of specimens of the species is relatively more in flowing water than *V. bengalensis*. (1, 8, 9, 13, 20, 26).

Measurements. H—21 mm. ; DM—19 mm. ; dm—14 mm. ; AH—12 mm. ; AW—9 mm.

Family AMPULLARIDAE

5. **Pila globosa** (Swainson) (Fig. 5)

This species, with a globose shell, is most familiar. The spire is depressed but the whorls are inflated. The surface is very smooth and glossy. The aperture is oblong oval with the margin slightly thickened. The umbilicus is small, contracted by the raised peristome which is slightly reflected. The colour of the shell is brownish olive with irregular red-brown conspicuous spiral bands. The interior of the shell is shiny with yellow tinge and transverse reddish bands. The transpiral growth striae occur on the last whorl and are stronger near the aperture.

Locality. This species is not collected from Poona City area but is common in the adjoining parts and is used for dissections.

Measurements. H—47 mm. ; DM—42 mm. ; dm—32 mm. ; AH—33 mm.; AW—20 mm.

6. **Pila** sp. (Fig. 6)

Since it has not been possible to determine its identity only a description of the shell is given here.

The shell resembles the preceding species ; it differs in the spire being much more depressed but the whorls are less markedly inflated and convex. Consequently, the spire is more conical. The surface of the shell is not smooth and glossy but roughened by transpiral striae. The striae are particularly prominent on the body whorl and give a wrinkled appearance. The aperture is ovate but very slightly narrowed above and rounded below. The lips of the aperture are feebly reflected and so the columellar lip does not occlude the umbilicus. One of the characteristics of the species is the conspicuous and wide umbilicus. In this respect it does not resemble *P. laygardi* (Reeve), *P. virens* (Lamarck), *P. nux* (Reeve), and *P. dolioides* (Reeve) with each of which it shares some characters. Moreover, it differs from these in coloration as the present species has a uniform olive-brown horny periostracum beneath which the shell is whitish. The interior of the aperture is whitish but towards the outer side is yellowish with irregular red bands.

Locality. The species is often collected along with *P. globosa* and presumably occurs in the same habitats. It is not available in the City limits.

Measurements. H—37 mm.; DM—33 mm.; dm—14 mm.; AH—28 mm.; AW—17 mm.

Series RISSOACEA

Family HYDROBIIDAE

7. **Bithynia stenothyroides** Dohrn. (Fig. 7)

The shell is small ovately globose with four to five whorls. The last whorl is strongly inflated and is larger than all the others together. The whorls are convex with the spire conical. The aperture is broadly oval with the lip continuous but feebly reflected. The shell is semi-transparent, glossy with a faint bluish tinge. The shell is devoid of any conspicuous sculpture. The operculum is concentrically striated.

Locality. This is one of the common species occurring in Poona. The species is abundant in slow-moving streams, ponds, pools, and tanks. Specimens have been collected from the underside of stones in the Vithalwadi canal and the University campus in wet season. They collect in large numbers and seem to be gregarious in habit. (12, 13, 14, 16, 19, 20).

Measurements. H—6 mm.; DM—4.5 mm.; AH—2.3 mm.; AW—1.7 mm.

Series CERITHIACEA

Family MELANIIDAE

S. Family MELANATRIINAE

8. **Sulcospira (Sulcospira) hügeli** var. **compacta** Nevill. (Fig. 8)

This is a shorter and stouter variety of *S. hügeli*. The body whorl is markedly angular and the spire is more truncate. The upper whorls are often found missing in older shells. The aperture is more or less contracted with the basal margin markedly produced below. The outer lip is sharp and thin. The columellar margin is smooth and white. The characteristic smoky-brown colour is darker in the dead shells. The spiral sulcations at the base of the body whorl are conspicuous.

Locality. The specimens are common in Poona and were collected from Pashan tank area and particularly in muddy habitats. (16, 17, 28, 30, 31).

Measurements. H—15 mm.; DM—9 mm.; AH—6 mm.; AW—4 mm.

S. Family MELANOPSINAE

9. **Faunus ater** (Linné) (Fig. 9)

The shells are elongatedly tapering and turreted with the whorls more or less flattened. The apex is acuminate and the sutures are well impressed. The lower whorls have widely-spaced spiral grooves mixed with dense transpiral striations on the surface. The aperture is small, ovately angled above but with a broad basal anterior canal. The columella is smooth, arched, and extends into a parietal callous. The labrum is sharp and thin. The surface is rough with iron rust colour and some specimens are bleached into yellowish olive-brown colour. The number of whorls are eleven to twelve with the following dimensions which are rather small compared to type specimens. But the species and its variety *F. ater* (Linnaeus) var. *perdecollata* Nevill. to which also this shows resemblance in coloration is extremely variable in size. Probably the specimens are not fully grown.

Locality. This species is quite common in Poona and is an inhabitant of small freshwater streams and brooks, occasionally of large ponds and river banks. They were usually found on muddy substrates. The specimens have been collected from Ambil Odha, Kothrud canal, Vithalwadi, and adjacent Mutha River. (1, 6, 7, 8, 9, 10, 12, 13, 16, 20, 26, 27, 31).

Measurements. H—36 mm.; DM—12 mm.; AH—10 mm.; AW—5.6 mm.

S. Family PALUDOMINAE

10. **Paludomus (Stomatodon) stomatodon** Benson (Fig. 10)

The shell is very thick and solid and has a neritoid form and appearance. The shell has a depressed spire with a very strongly inflated body whorl. The aperture is sigmoidly oval with a tooth-like projection in its basal margin. The apices of the spire are usually worn out or damaged. The shell is dark olive-brown but the apex is black.

Locality. Species belonging to this and other related genera are known to occur in Maharashtra but it is rare in Poona. Some shells were collected from the bank of Mutha River where Vadagaon stream joins it. The approach to this place is from Vithalwadi temple. Nowhere else have the shells been noticed again.

Measurements. H—21 mm.; DM—17 mm.; dm—14 mm.; AH—17 mm.; AW—10 mm.

S. Family MELANIINAE

11. **Melania (Plotia) scabra** (Müller) (Fig. 11)

Quite apart from the other characteristics which separate this species from the succeeding one it is more broad in proportion to height than

M. tuberculata. The whorls of the spire bear spinous shoulders in their upper part. The whorls also bear well-developed transpiral ridges with spiny processes. The aperture is ovate. The shell is variable in its coloration but usually is brownish olive, spotted with few rust-coloured transpiral marks. The apical region is often darker than the body and the penultimate whorl. The prominent angular ridges and the spinous processes are often worn out in older specimens.

Locality. The species is quite common in Poona. The specimens were found to inhabit flowing clear water and sandy and gravelly habitats. (1, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 21, 22, 24, 25, 27, 28, 29, 30).

Measurements. H—20 mm.; DM—12 mm.; dm—9 mm.; AH—7.5 mm.; AW—5 mm.

12. **Melania (Plotia) scabra** (Müller) var. **elegans** Hutton (Fig. 12)

This is a variety of *M. scabra* and deserves separate treatment as has been given by other authors. The shell is markedly thick, more solid with a turreted spire. The whorls have well-developed angular shoulders which are occasionally provided with spinous projections. The small oval aperture is sinuous above and rounded below. The colour is variable between pale brown and sandy brown with fine reddish transpiral wavy elegant marks.

Locality. This species is quite common in Poona and is found to occur in similar and often the same habitats as the *M. scabra.*

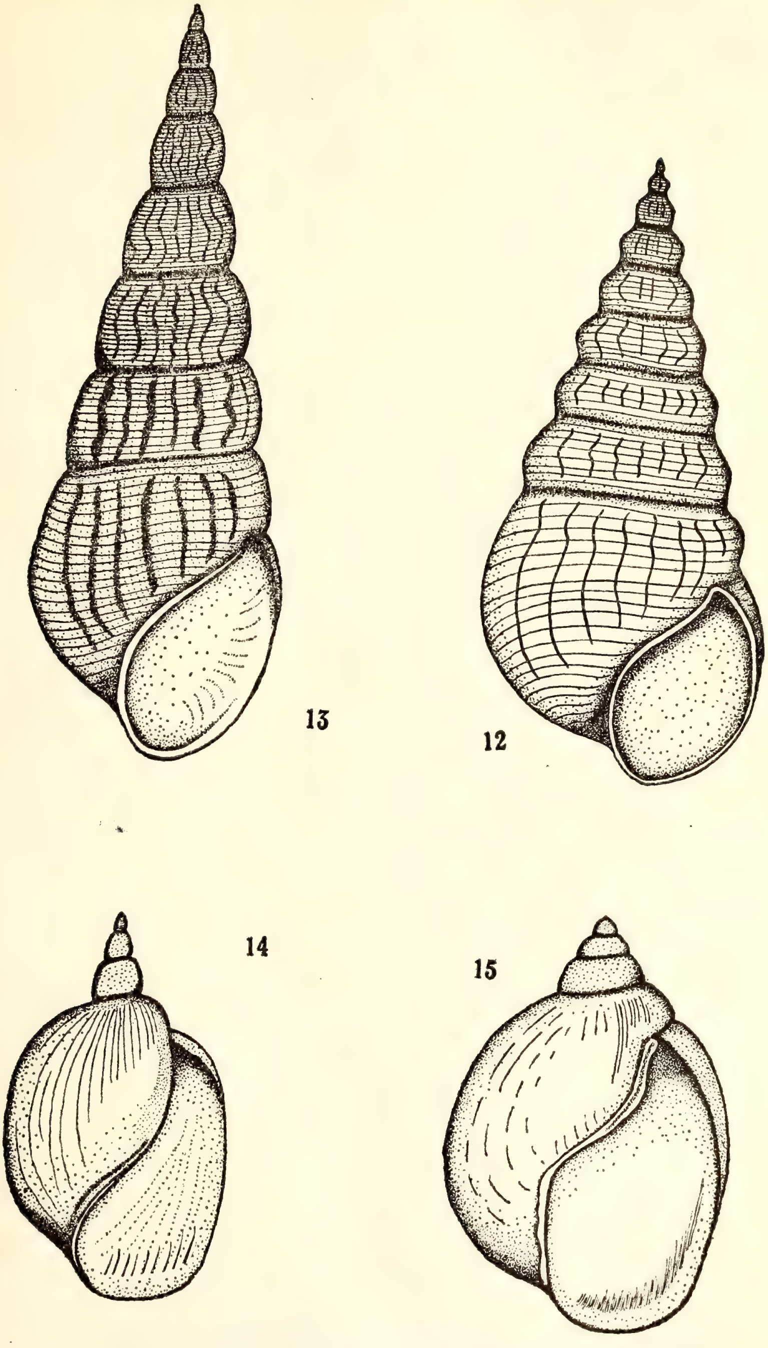
Measurements. H—20 mm.; DM—8.5 mm.; dm—7.5 mm.; AH—8 mm.; AW—4.5 mm.

13. **Melania (Striatella) tuberculata** (Müller) (Fig. 13)

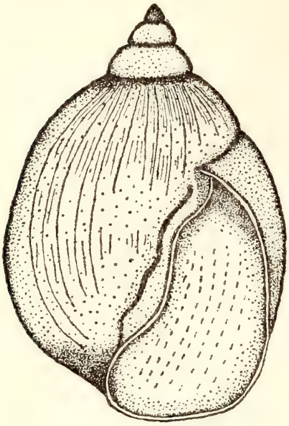
The shell is elongated with an acuminate apex. The whorls are neatly convex and progressively increase towards the body whorl. The aperture is oval but more narrowed above and broadly rounded below. The sculpture consists of transpiral tuberculated ridges with raised spiral striae. The body whorl is usually devoid of transverse tuberculated ridges. The colour of the shell is dark brown with rows of reddish undulating flame-shaped discontinuous bands. The interior of the shell is glossy with external marks faintly visible.

Locality. Living specimens and dead empty shells were invariably found in clear running water. The specimens have been collected from a large number of localities of which the following were found to contain relatively more abundant number of the species: 1, 3, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 21, 24, 25, 26, 28, 29, 31.

Measurements. The measurements of a specimen collected from the University area are as follows: H—30 mm.; DM—9 mm.; dm—7.5 mm.; AH—8 mm.; AW—5 mm.



12. *Melania* (*Plotia*) *scabra* var. *elegans* Hutton × 4 ; 13. *Melania* (*Striatella*) *tuberculata* (Müller) × 3 ; 14. *Lymnaea acuminata* Lamarck × 1.5 ; 15. *Lymnaea luteola* Lamarck × 2.5



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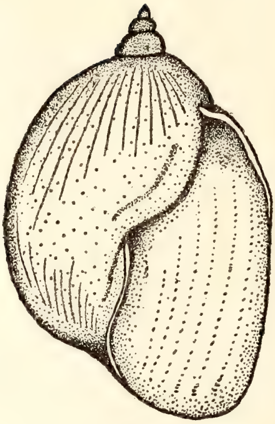

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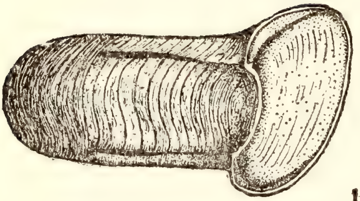

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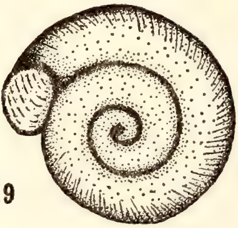

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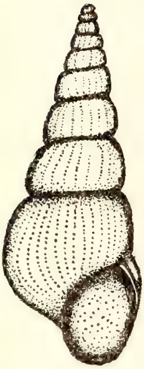

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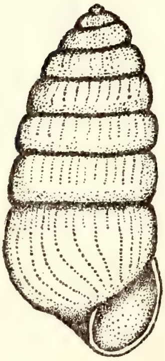

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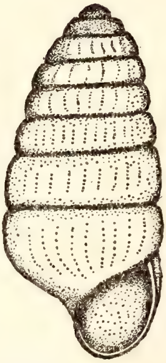

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16. *Lymnaea pinguis* Dohrn. ×2 ; 17. *Lymnaea auricularia* (Draparnaud) × 2 ; 18. *Planorbis* (*Indoplanorbis*) *exustus* (Deshayes) × 3 ; 19. *Anisus* (*Gyraulus*) *convexiusculus* (Hutton) × 2.5 ; 20. *Opeas gracile* (Hutton) × 4 ; 21. *Zootecus chion* (Pfeiffer) × 4 ; 22. *Zootecus insularis* (Ehrenberg) × 4

S. Class	PULMONATA
Order	BASOMMATOPHORA
Series	HYGROPHILA
Family	LYMNAEIDAE
S. Family	LYMNAEINAE

The genera of non-operculate thin-shelled freshwater snails have a world wide distribution and are exceedingly plastic. A large number of varieties of each species has been described by previous authors.

14. **Lymnaea acuminata** Lamarck (Fig. 14)

The shell is ovately oblong, smooth, thin, and semi-translucent. The body whorl is slightly angular above and inflated below the middle. The spire is short, narrow, with the attenuated whorls forming a pointed apex. The aperture is wide with the columellar lip twisted. There is a fine close-set transpiral striation on the surface of the shell. The body whorl is clearly demarcated from the spire with an abruptly narrowed base.

Locality. This is a common and widely distributed species inhabiting ponds, pools, and ditches with abundant aquatic vegetation with sphagnum. (1, 2, 3, 4, 6, 12, 15, 16, 19, 20, 29, 31).

Measurements. A dry shell from Law College Ponds measured : H—31 mm. ; DM—18 mm. ; AH—24 mm. ; AW—10 mm. ; Body whorl—27.5 mm. ; Spire—4.5 mm.

15. **Lymnaea luteola** Lamarck (Fig. 15)

The shell is broader in proportion to the height in this species than in *L. acuminata*. The spire is short, conical, with a broader base which gradually merges with an inflated body whorl. The whorls of the spire are clearly inflated. The ovate aperture is rather angularly narrowed above but is rounded below. The shell is smooth, glossy, with a pale yellow horny tinge. The sculpturation consists of close-set fine transpiral striations, which are seen only under binocular microscope. In addition to these a few widely-spaced spiral striae were also seen. The colour of the columellar fold is opaque white and is a rather characteristic feature of this species.

Locality. This species has been so far noticed only in streams and standing water on the banks of rivers Mula and Mutha. They were found attached to various floating objects such as twigs. (1, 7, 8, 9, 13, 21, 22, 23, 24, 26, 31).

Measurements. H—18 mm. ; DM—10 mm. ; AH—10 mm. ; AW—6 mm.

16. **Lymnaea pinguis** Dohrn. (Fig. 16)

The shell is ovately oblong or more or less spindle-shaped. The shell is narrower in the middle in relation to its height than the other *Lymnaea* species. The spire is elevated and consists of about four whorls which are slightly concave. The spire terminates in an acute apex. The body whorl is elongately ovate, inflated, and measures more than two-thirds of the total length. The aperture is slightly oblique and elongately oval. The outer lip is thin and the columellar lip slightly reflected and bears callus. The surface of the shell is closely striated transpirally. The shell is pale horny brown and semi-translucent.

Locality. This is a very widely distributed species occurring on Mutha River banks and in ponds and pools. The specimens were collected from habitats with abundant sphagnum and other emergent aquatic vegetation. (1, 2, 3, 4, 5, 7, 13, 16, 19, 20, 29).

Measurements. H—22 mm.; DM—10 mm.; AH—16 mm.; AW—9 mm.

17. **Lymnaea auricularia** (Draparnaud) (Fig. 17)

The shell is semiglobose, squarish, and rather thin, with pallid horny colour. The conical spire consists of three whorls which are convex and form a sharply pointed apex. The body whorl is abruptly widened and is greatly inflated. The large and broad aperture has a thin and expanded outer lip. The columellar lip is callus, twisted, and covers the narrow umbilicus. The surface of the shell is irregularly striated in the direction of the lines of growth.

Locality. This species is very cosmopolitan in distribution and occurs in every type of habitat. It has been noticed in all the spots visited and particularly in standing water.

Measurements. H—22 mm.; DM—13 mm.; AH—16 mm.; AW—8.7 mm.

Family PLANORBIDAE

18. **Planorbis (Indoplanorbis) exustus** (Deshayes) (Fig. 18)

It has been quite difficult to determine the identity of the various Planorbids collected in the course of this work. The species is extremely variable in its size, form of its spire, and other architectural details.

The shell is relatively large, moderately thick, and flattened on both sides. The shell is usually sinistral, discoidal, with the spire depressed and sunk in the expanded body whorl. The three whorls are quite convex and are spirally coiled in the horizontal plane. The basal part of the shell shows the wide umbilicus and the whorls of the spire. The aperture is ear-shaped and enlarged. The outer lip is relatively thickened and feebly reflected outwards. The shell is transpirally and finely striated throughout, and the body whorl shows more distinct transpiral ridges. The range of variation in colour is considerable.

Locality. The species has been collected from sluggish streams, stagnant ponds, marshy spots, and is so common that none can miss it. The presence of haemoglobin enables them to inhabit even foul water. Specimens were collected even from portion of the Mutha River where the city sewage flows out (almost everywhere except fast flowing rivers and streams).

Measurements. H—7 mm. ; DM—15 mm. ; dm—10 mm. ; AH—10 mm. ; AW—7.5 mm.

19. **Anisus (Gyraulus) convexiusculus** (Hutton) (Fig. 19)

This is one of the smallest mollusca recorded in this account. The shell is strongly depressed with the sunken spire giving an appearance of a flattened disc. The shell is dextral with four to five whorls and has well-defined sutures. The oblique aperture is lunately oval with the outer lip evenly rounded. The umbilicus is wide, exposing the involutions from below. The surface is polished and of pale horn colour, with close-set oblique transpiral striae.

Locality. The species is common and occurs in abundance in tanks, ponds, ditches, and many other places with vegetation. It is widely distributed. The one figured and measured is from the University campus. (2, 3, 4, 5, 12, 16, 19, 20, 29).

Measurements. H—1.78 mm. ; DM—6.5 mm. ; dm—4.5 mm. ; AH—1.80 mm. ; AW—2 mm.

Order	STYLOMMATOPHORA
Series	ACHATINACEA
Family	SUBULINIDAE
S. Family	OPEATINAE

20. **Opeas gracile** (Hutton) (Fig. 20)

The shell is small, thin-walled, and turreted. The spire is gradually tapering and the apex is rounded. The body whorl is conspicuous and equal to two preceding ones. The number of whorls is variable from eight to twelve. The aperture is distinctly longer than broad, semi-ovate, but slightly narrowed above. The columellar lip is almost straight and partly reflected, while the outer lip is thin and sharp-edged. The shell is uniformly pale-horny-coloured but variable in the different hues of yellow colour. Striae are not discernible to the naked eye.

Locality. A couple of specimens were collected from the Mula River near Yerawada. The species is reported from Poona before and has a wide range of distribution. However, it is not so common in the Poona area.

Measurements. H—9 mm. ; DW—2.9 mm. ; AH—2.8 mm. ; AW—1.9 mm. The measurements are smaller than those given by previous authors.

S. Family RUMININAE

21. **Zootecus chion** (Pfeiffer) (Fig. 21)

The shell is of moderate size, smooth, and glossy. The spire is elongated and terminates in a conical apex. There are seven whorls, of which the body whorl is large and is approximately one-third the total length and is well rounded below. The penultimate and ante-penultimate whorls are almost as broad as the body whorl. Thus the shell has a characteristic cylindrical pupiform appearance. The aperture is semi-oval with inner lip slightly reflected to partly occlude the umbilicus. The peristome is slightly thickened, with callus. The surface of the shell is covered by close-set fine transpiral striae.

Locality. The species is represented by a single intact shell. The specimen was collected from the banks of Mula-Mutha River near Bund Garden. This species has not been reported before from Poona.

Measurements. H—12 mm. ; DM—5 mm. ; dm—4 mm. ; AH—3 mm. ; AW—2.2 mm.

22. **Zootecus insularis** (Ehrenberg) (Fig. 22)

The shell is pupiform, subcylindrical, and thin. There are about seven-and-a-half whorls and they are moderately convex. The body whorl is slightly above the aperture. The aperture is semi-oval pointed above with the columellar margin dilated, thickened, and partially covering the narrow umbilicus. The sculpture consists of close-set fine subvertical striae. The shell is translucent, corneous-white.

Locality. The specimen was collected from the same locality as the preceding one.

Measurements. H—8.5 mm. ; DM—3.7 mm. ; dm—1.8 mm. ; AH —18 mm.; AW—1.3 mm. The species is extremely variable in size but the specimen measured here confirms to the measurements given by Gude (1914).

Series ARIOPHANTACEA

Family ARIOPHANTIDAE

S. Family MACROCHLAMYDINAE

23. **Macrochlamys pedina** (Benson) (Figs. 23 & 24)

The genus *Macrochlamys* is represented by a little over hundred species in this continent and it is difficult to recognise the different forms as the differences in the shells are so small indeed, that they had to be arranged according to locality (Blanford & Godwin-Austen, 1908).

The shell is depressed, very thin, and translucent. The spire is conoid but very low. The whorls are six-and-a-half to seven in number and are slightly convex above. The body whorl is bluntly subangulate above the periphery but rounded below. The lunately round aperture is oblique to the axis. The peristome is thin, while the columellar lip is vertical and reflected to cover part of the umbilicus. The umbilicus is wide and conspicuous. The shell is more or less smooth with minute close-set transpiral striations. The colour is variable from pale yellow to fulvous horny.

Locality. This species has been reported from Poona and is known to be common in a considerable part of old Bombay Presidency. The specimen was collected from the vicinity of a tank in the Poona University campus.

Measurements. H—15 mm. ; DM—33 mm. ; AH—14 mm. ; AW—8.5 mm. The measurements are slightly more than those given by Blanford & Godwin-Austen (1908). This is one of the largest Indian species.

24. **Macrochlamys infausta** Blanford (Fig. 25)

The shell is thin, depressed, and subglobose. There are six whorls, rather convex, with well-impressed sutures. The spire is very low and broadly conoidal. The body whorl is relatively broader and rounded at the periphery. The aperture is oblique to the axis, and is lunately round. The peristome is thin and the columellar margin curved and carried forward without being reflected. The sculpture consists of fine close-set longitudinal striae. The shell is translucent, delicate, and fragile, with a dull oily lustre above. The colour is brownish tawny and glassy below. The species differs from *M. pedina* by its smaller size, rounded periphery, and relatively more open perforation.

Locality. The species is quite common in gardens and parks. Specimens were collected from the ponds of the Sambhaji Park and the University campus. (1, 4, 5, 8, 19, 20).

Measurements. H—9 mm. ; DM—18 mm. ; dm—15 mm. ; AH—8 mm. ; AW—5 mm.

25. **Cryptozona (Xestina) belangeri** var. **bombayana** (Pfeiffer) (Fig. 26)

The shell is large, more or less globose, with depressed and low spire. The whorls are slightly inflated and distinctly convex with well-impressed sutures. The aperture is roundly lunate, not as broad as high. The peristome is thin and the columellar margin is slightly reflected. The surface of the shell is obliquely striated with decussated impressed lines which are sometimes absent. The basal region is relatively smooth. The colour is extremely variable, ranging from dull white, pale horny, and sometimes to tawny brown.

Locality. This is considered as a variety of *C. belangeri* on account of its small size. There is significant variation in the size of shells collected from different localities. The species is available in large numbers in the Poona University campus especially during the wet season. (19, 20).

Measurements. One specimen: H—25 mm.; DM—28 mm.; dm—22 mm.; AH—20 mm.; AW—14 mm.; Another specimen: H—20 mm.; DM—24 mm.; dm—18 mm.; AH—15 mm.; AW—10.5 mm.

26. **Ariophanta laevipes** (Müller) (Fig. 27)

The shell is relatively depressed, rather thin, with coloured bands. The spire is low, and there are five whorls which are more or less convex. The body whorl has an angulated periphery but is rounded below. The apex is depressedly conoidal. The aperture is very oblique and almost diagonal to the axis. The peristome is moderately thickened and reflected below. The shell is obliquely striated and decussated with fine spiral lines. The lower part of the body whorl is smooth. The ground colour of the shell is variable from white to brown or dark brown. But the species is characterised by three spiral chestnut bands, one close to the suture, and one above and one below the periphery. The parietal wall of the aperture and the area surrounding the umbilicus (Periomphalus) have the same colour as the body whorl.

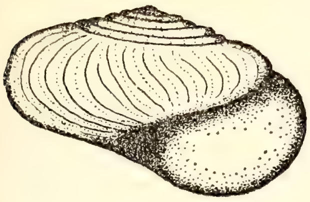
Locality. The specimens are not so abundant in Poona as *Cryptozona.* The species is common in gardens and the specimens in the collection are from the University campus. (19, 20).

Measurements. H—17 mm.; DM—28 mm.; AH—11 mm.; AW—8 mm.

27. **Ariophanta bajadera** (Pfeiffer) (Fig. 28)

The shell is of moderate size and rather thin. The spire is bluntly conical with apex which is broadly obtuse. There are four-and-a-half to five whorls which are convex with the well-impressed sutures. The body whorl is swollen and rounded at the periphery. The body whorl is slightly inclined below at the aperture. The aperture is diagonal to the axis and roundly lunate. The peristome is thin and whitish. The surface of the shell is sculptured with coarsely plicate striae but is relatively smooth below the body whorl. The shell is brownish horny and is glossy.

Locality. A few broken pieces together with an intact empty shell were collected from the banks of Mutha River near Vithalwadi (Araneyeshwar). The area was covered with small shrubs. The specimens were few and probably this species is not so common. (20, 23).



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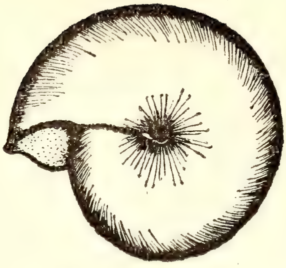

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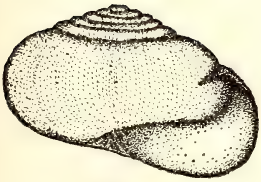

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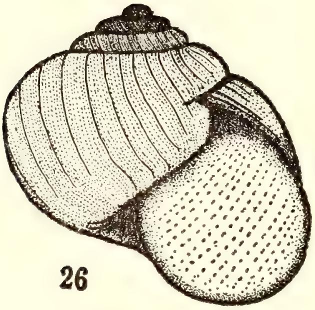

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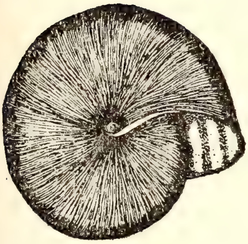

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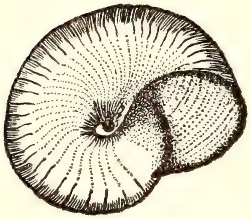

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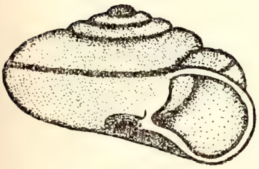

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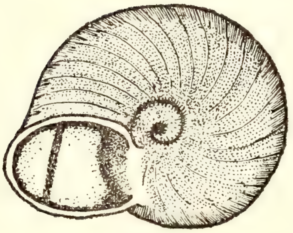

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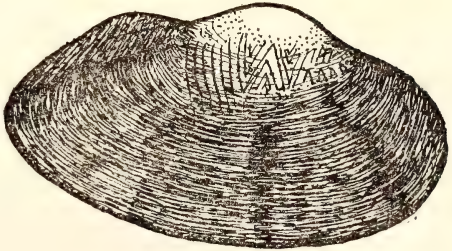
23. *Macrochlamys pedina* (Benson) × 1 ; 24. *Macrochlamys pedina* (lower view) × 1 ; 25. *Macrochlamys infausta* Blanford × 1.5 ; 26. *Cryptozona* (*Xestina*) *belangeri* var. *bombayana* (Pfeiffer) × 1.3 ; 27. *Ariophanta laevipes* (Müller) (lower view) × 1 ; 28. *Ariophanta bajadera* (Pfeiffer) (lower view) × 1 ; 29. *Planispira proxima* (Férussac) × 1.5 ; 30. *Planispira proxima* (Férussac) (lower view) × 1.8



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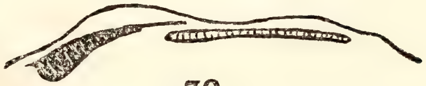

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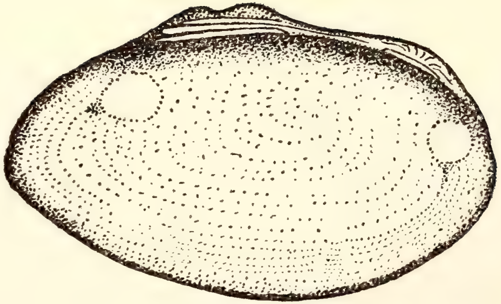

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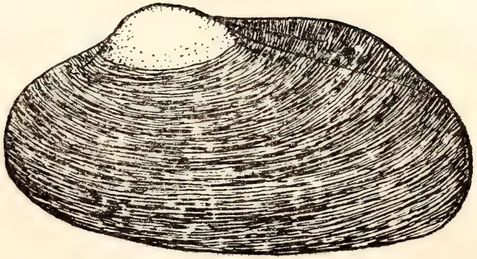

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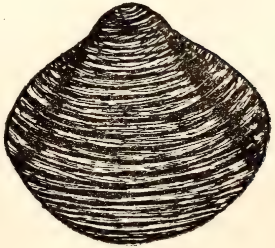

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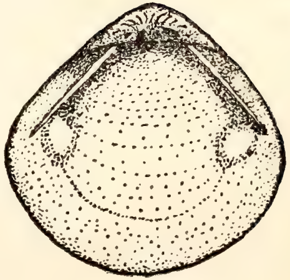

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31. *Parreysia* (*Parreysia*) *corrugata* var. *nagpoorensis* (Lea) × 1.5 ; 32. *Parreysia* (*Parreysia*) *corrugata* var. *nagpoorensis* (Lea) × 1.5 (hinge) ; 33. *Lamellidens marginalis* (Lamarck) (inner view of the left valve) ; 34. *Lamellidens corrianus* (Lea) ; 35. *Corbicula regularis* Prime (outer view) × 1.2 ; 36. *Corbicula regularis* Prime (inner view) × 1.2

Measurements. H—20 mm. ; DM—27 mm. ; dm—20 mm. ; AH—14 mm. ; AW—12 mm.

Series	HELICACEA
Family	PLEURODONTIDAE

28. **Planispira proxima** (Férussac) (Figs. 29 & 30)

The shell is moderate in size, conoidly depressed, and is rather globose. The whorls are five to five-and-a-half in number, increasing rapidly in size until the body whorl is dilated near the aperture. The whorls are convex and sutures are deeply impressed. The apex is obtuse as the spire is depressed. The body whorl is slightly inclined towards the aperture, which is somewhat oblique to the axis and is broadly ovate. The margins of the aperture approach towards each other and are united by a thin callus on the parietal wall. The peristome is thickened, expanded, and reflected. The umbilicus is moderately open and more or less perspective. The sculpturation consists of close-set, rather coarse, oblique transpiral striations. The colour of the shell is light fawn with a brown band at the periphery.

The genus is characterised by the body whorl strongly deflexed in front and the converging ends of the aperture. The species shares some characters with *P. albicostis*, *P. fallaciosa*, *P. crassicostata*, *P. colletti*, *P. footei*, and *P. vittata*, but can be separated from them on the basis of the above characters.

Locality. The genus has been reported from Poona and the adjoining parts of Maharashtra. The shells are not common. A couple of good specimens were collected from Mutha River banks near Vithalwadi.

Measurements. H—12 mm. ; DM—21 mm. ; dm—15 mm. ; AH—9 mm. ; AW—8.5 mm.

Class	PELECYPODA (BIVALVIA)
Order	EULAMELLIBRANCHIATA
S. Order	SCHIZODONTA
Series	UNIONACEAE
Family	UNIONIDAE

29. **Parreysia (Parreysia) corrugata** var. **nagpoorensis** (Lea) (Figs. 31, 32)

The shell is of large size, transversely ovate, sub-triangular and inequilateral. The shell is moderately inflated and the valves are almost as long as high. The anterior end is narrowly rounded, while the posterior end is more or less broadly angular above and below. The prominent umbo is slightly inclined forwards. The periostracum is rufous-brown tinged with green towards the ventral margin. The umbonal region is ornamented with divaricating obliquely radial ridges. The hinge margin is slightly inclined downwards in front of and behind the umbo. The inner surface of the shell is pearly, slightly pinkish, and brilliantly iridescent. The cardinals are strong, jagged, and crenulated. The laterals are lamellar, elongated, and slightly curved.

Locality. The specimens are quite common on the banks of Mutha, Mula, and Mula-Mutha Rivers. The empty shells have also been noticed in the canals which have more or less permanent water throughout the year. (20, 23, 24, 25, 26).

Measurements. L—45 mm. ; H—22 mm. ; DV—20 mm.

30. **Lamellidens marginalis** (Lamarck) (Fig. 33)

The shell is oblongly ovate, approximately twice as long as high, and relatively more inflated. The umbones are prominent. The anterior margin is narrower than the posterior, the former evenly rounded while the latter is roundly angular. The shell is thin and covered with blackish brown or greenish brown epidermis which is frequently worn away in the adult shells and more particularly near the umbones. The inner surface is iridescent and pearly.

Locality. This species is available in Poona but is not so common as the next one. The species is available in the Mula-Mutha River ; the specimens were collected from the river near Yerawada and a mile further up.

Measurements. L—76 mm. ; H—40 mm. ; DV—30 mm.

31. **Lamellidens corrianus** (Lea) (Fig. 34)

The shell is narrowly elliptical, strongly transverse, and is longer in proportion to the height. The valves are relatively thin. The anterior margin is rounded, while the posterior margin is sub-angular. The beaks are not so prominent and usually the periostracal layer is eroded in fully grown shells. The ventral margin is roundly curved. The cardinal teeth, single in the left valve and paired in the right valve, are thin and bladed. The lateral teeth are elongated and nearly straight. The pearly white iridescence of the nacreous layer is characteristic.

Locality. This species is more common in Poona rivers than *L. marginalis*, of which this was considered as a variety. Specimens are available in Mula and Mutha rivers.

Measurements. L—74 mm. ; H—37 mm. ; DV—20 mm.

S. Order	HETERODONTA
Series	SPHAERIACEA
Family	CORBICULIDAE

32. **Corbicula regularis** Prime (Figs. 35, 36)

The shell is triangular, ovate, transverse, and equilateral. The anterior and posterior margins are similarly rounded. Externally the shell is strongly and concentrically striated. The periostracum is dark brownish green while the interior is violet and glossy. The hinge bears three divergent cardinal teeth which are well developed in each valve. The lateral teeth are elongated, lamelliform, and bear fine transverse striae. The pallial line is continuous and is distinct with a shallow pallial sinus.

Locality. This is a common species in this area and empty shells are abundant on the banks of the river. The specimens were collected from many places near the rivers which had a muddy bottom.

Measurements. L—25 mm. ; H—20 mm. ; DM—14 mm.

CONCLUSIONS

A consideration of the preceding systematic account leads to a few generalisations and the following points of interest :

i. The species belonging to the genera *Cyclophorus* and *Paludomus* do not seem to be the true residents of the area investigated. It is probable that they are washed down from the westerly mountainous region.

ii. The small size of the species of *Opeas* and *Zootecus* adds to the difficulties in their detection in the field. Even so they have been reported previously from this region and are probably distributed more widely than indicated here.

iii. The most common Molluscan residents of Poona are the species belonging to the Gastropod genera, viz. *Vivipara*, *Bithynia*, *Melania*, *Lymnaea*, *Planorbis*, *Anisus*, *Macrochlamys*, *Cryptozona*, and *Ariophanta*. The Pelecypoda, represented by the genera, viz. *Parreysia*, *Lamellidens*, and *Corbicula*, are equally common.

iv. Other genera such as *Rachis*, *Cerastus*, *Euplecta*, and *Ptychotrema* of Gastropoda and *Nodularia*, *Vellorita* of Pelecypoda are not only known to occur in this region but have also been collected in the course of the present study. However, they have not been included in this account as these genera contain several annectent forms and their exact identity is being determined.

v. It has been noticed in the course of this work that the various species of the genus *Planorbis* are difficult to separate on the basis of only the shell characters.

ACKNOWLEDGEMENTS

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The nidification of some common Indian birds—Part 1

BY

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INTRODUCTION

Very little is known about the breeding habits of common Indian birds. Monumental works of savants like Hume (1873, 1889) and Baker (1932) on the subject of nidification deal mainly with the breeding seasons, situation and location of nests, descriptions and measurements of nests and eggs. Many interesting aspects like courtship, nest building, territory, incubation, etc. have been completely left out in the majority of the cases. Although many ornithologists and naturalists have written from time to time about one or more of these aspects of some species or the other, yet our present knowledge of the subject remains sadly deficient.

Material and method. I first got interested in the subject while I was working on the systematics of birds of Hoshiarpur at Panjab University during 1951-52. But the really good opportunity to pursue my interest was provided by the Virus Research Centre, Poona[1], where I worked during 1953-57. In 1953 the Virus Research Centre became interested in nestling birds considering the possibility of their being potential propagators of arthropod-borne viruses. I was asked to keep an eye on the breeding pattern of some of the common species of birds in and around Poona. Accordingly, nests of common species of birds in and around Poona were located by scouting the area. A systematic record was kept of the situation and location of the individual nests. The nests were visited at intervals of one to four days and the contents noted after having a look at the nest. Similar observations were repeated at the Vellore (N. Arcot, Madras) Field Station of the V. R. C., Poona, in 1955-56 and at the Akividu (W. Godavari, Andhra) Field Station in 1956-57 where, in addition to the resident breeding birds, many species of water birds collect in enormous numbers to breed in and around Kolair Lake. On joining the Zoological Survey of India in December

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[1] The Virus Research Centre is jointly maintained by the Indian Council of Medical Research and the Rockefeller Foundation.

1957, I was encouraged to keep up my studies, and made observations in and around Calcutta, at Chilka Lake (Puri, Orissa), and in the Balaghat Forest Division (Madhya Pradesh).

Data gathered from these observations and other observational notes kept from time to time are being utilised in the preparation of this series.

Acknowledgements. I am indebted to the Director, Virus Research Centre, Poona, and the Director, Zoological Survey of India, Calcutta, for the facilities extended for carrying out these studies. I express my thanks to Dr. J. Austin Kerr and Dr. Telford H. Work of Virus Research Centre, Poona, Lt.-Col. S. L. Kalra of the Armed Forces Medical College, Poona, Dr. B. Biswas of the Zoological Survey of India, Calcutta, and Dr. Sálim Ali and Mr. Humayun Abdulali of the Bombay Natural History Society for their helpful suggestions. I also thank Prof. G. P. Sharma, Head of the Department of Zoology, Panjab University, Chandigarh, for having initiated my interest in the subject.

1. THE COMMON INDIAN HOUSE CROW, *Corvus splendens* (VIEILLOT), WITH NOTES ON BROOD PARASITISM ON IT BY THE INDIAN KOEL, *Eudynamys scolopacea* (LINN.)[1]

Previous work. The Common Indian House Crow needs no introduction. It is by far the commonest bird of India and yet not much is known about its nidification. Hume (1873 : 413-14) was perhaps the first ornithologist to collate the data then available on the subject. But the information was rather sketchy and far from complete. Many interesting aspects like courtship, nest building, territory, incubation, mortality in young and feeding the young, etc. were, however, left completely untouched even in his later (Hume 1889 : 8-12) and more elaborate compilation, presumably because nothing much was then known about them. Dewar (1905) gave a very useful, still more elaborate and original account of the breeding habits of this bird, but he too failed to throw any light on some of these aspects, especially territory, incubation period, and mortality in the young. Many ornithologists and naturalists (Adam, 1873 ; Butler, 1875 ; Davidson, 1878 ; Cripps, 1878 ; Scully, 1879 ; Doig, 1879 ; Vidal, 1880 ; Ried, 1881 ; Swinhoe, 1885 ; Barnes, 1886 ; Davidson, 1887 ; Taylor, 1887 ; Oates, 1889a ; Munn, 1894 ; Jesse, 1902 ; Fergusson, 1903 ; Prater, 1926 ; Ali, 1926, 1946, 1953 ; Ali & Abdulali, 1937 ; Baker, 1926, 1932 ; Whistler, 1928 ; Inglis, 1931-34 ; Rao, 1936 ; Sen, 1947 to cite a few) have written about the nidification of this bird from time to time but the subject is still far from exhausted.

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[1] This section is based almost entirely on observations made when I was working with the Virus Research Centre, Poona.

Breeding season. The breeding season of the common Indian House Crow, *Corvus splendens* (Vieillot), seems to differ slightly in different parts of India. In this connection Hume as early as 1889 stated that the ' breeding season par excellence is June and July but an occasional nest will be found earlier even in Upper India and in Southern and Eastern India a great number lay in May '. According to Dewar (1919 : 27-28) the breeding season of this species 'in Northern, Western and Central India is June to August, most eggs being laid between June 10th and 30th. In Bengal and Burma from March to May, also in January and December. In South India from April to June, a few birds however, nest in November and December or February and March.' Whistler (1928 : 8) remarked that the ' breeding season is very regular in the North-west, eggs being laid from the middle of June till the middle of July. In the rest of India numbers lay in April and May and occasionally nests are found in November, December and January.' Baker (1932 : 16) writing on the subject stated : ' Over Eastern Bengal, Bihar and Arakan the normal breeding season is March and April but in Dacca and Mymensingh there are two well-defined seasons : December, January and February in winter and April, May, and rarely June in the hot weather. In Ratnagiri and in other parts of Bombay Presidency Messrs. Vidal and Davidson found that they had two similar seasons, the principal months being November and December and then again in April and May. Over the rest of India the favourite months seem to be June and July.' Ali (1946 : 2) writing on the subject states : ' In Western India, House-Crows nest between April and June, in Bengal slightly earlier ; while in the heavy rainfall areas of SW. India breeding is usually over before the onset of the South-west Monsoon in May.'

Around Poona where a part of this study was made, the breeding season commenced by the end of April, most eggs and nests were found in May-June, and fledglings in June-July. Occasional nests were also met with in August. On the other hand at Vellore (N. Arcot, Madras) where a major portion of the present work was executed the nests did not start coming up till nearly the middle of May. Most of the eggs were found in June and most fledglings in July. The breeding season lingered fairly well into August, when a few nests with fledglings could be located.

Mating. With the advent of the breeding season large flocks, which feed and habitually hang about near markets, rice and ground-nut mills, municipal refuse-dumping grounds and cultivated fields, start breaking up. Partners are now sought out and courted. The pairs keep fairly close together even when feeding. At this time if any one happens to look for crows one can find them sitting in pairs on shady trees or in other shady spots, resting after their meals, during the hottest part of the day.

Apparently the crow does not like to make a public exhibition of its connubial affections. Whereas it does not mind a little indulgence in public, by way of head-tickling in a tree, on a house top, or any other convenient spot, it is rather discreet about its sexual intercourse. Although the most common bird everywhere, very rarely indeed does one observe crows copulating. Copulation usually takes place in trees, sometimes on house tops or on the ground, and occasionally even in the middle of a busy road (Acharya, 1951). No particular part of the day is preferred, and it is most frequent when the nest is under construction. It may be preceded by mild spooning (head-tickling) or the passage of a toothsome morsel from male to female but, as frequently as not, it comes off without any preliminaries. The male having secured a hold on the female's head with his beak mounts on her back, and she in turn sits quietly with neck drawn in and wings spread out a little. Balancing himself with his foot-and-beak hold the male brings his hind quarters down to effect a cloacal connection. The whole process hardly takes a few seconds. Sometimes, however, the male is not able to establish the connection at the first attempt, either because of losing his balance while lowering his hind part or owing to the movement of the female at the crucial moment under his weight. In such cases the male lowers his hind quarters a number of times against the female cloacal opening.

Nest building. Mating in crows is indicative of the fact that they have either started building nests or are going to do so shortly. The first step towards the construction of the nest is the selection of a suitable site, of which there appears to be no lack for the House Crow. It is not known which sex makes the final decision as regards the suitability of the site, but I have reasons to believe that the female does have an important say in the matter. It is not an uncommon sight in the breeding season to see a bird, stick in beak, moving from one tree to another, hesitant to put it down, being followed closely by another bird with or without a stick. On three such occasions I have shot the leader in order to determine the sex and all the three turned out to be females.

A thin vertical fork near the top of the tree, or on one of the outermost branches of any of the larger trees like *Dalbergia sissoo*, *Acacia arabica*, *Tamarindus indicus*, *Melia azadirachta*, or *Ficus* is a favourite site. But in the localities where large trees are wanting or have already been occupied by others of its own species, it does not hesitate to avail itself of other sites provided by smaller trees, edges and nooks of buildings (Hume, 1889 : 8 ; Baker, 1932 : 17), telephone and telegraph poles and wires (Dewar, 1905 : 25). It is seldom that a site inside a building is selected; the most famous and historic of such cases on record is that reported by Benjamin Aitken to A. O. Hume (1889 : 10) of a pair of Madras crows who selected the very narrow top ledge of a pillar in the verandah of an office to construct a nest and took nearly five months to finally build a nest which did not fall off the ledge. The site selected is invariably in or near human habitation.

After the site for the nest has been selected construction starts in right earnest. Both the birds go hunting for twigs/sticks together. Dry, usually thorny, sticks and twigs are picked up from under trees, hedges around the fields and farms, and from the firewood piles of the poorer classes of labourers who collect dry sticks for cooking. If fallen sticks are not easily available, green twigs are wrenched off trees. Having secured a stick the female returns directly to the nesting site to fix it in position. The male usually accompanies her back even if he has not yet secured or found a stick of his own, though he usually manages to find one. The female first arranges her stick, and later the one passed on to her by the male if he has brought one. The male does not do any actual building himself but waits till she has fixed both the sticks and then they fly off together in search of more. The arranging of a stick generally does not take more than a few seconds. However, when a difficult spot is reached it may take a couple of minutes for the female to adjust a projecting stick to her satisfaction. As many as thirty sticks may be brought and arranged in an hour during the peak of building activity.

In the earlier stages of construction the sticks are arranged in the fork in criss-cross fashion resulting in a circular platform 22-27 cm. in diameter. When this platform is three to four sticks thick, additional sticks are laid on it tangentially, converting it into a shallow cup 7-10 cm. high and 5-8 cm. thick. The sticks, however, are not the only material used in the construction of this outer cup. Instances are on record when soda-water bottle wires, brandy bottle wires (Hume, 1889 : 9, Baker, 1932 : 16, Dewar, 1929 : 27-28), and gold and silver spectacle frames (Dewar, 1905 : 26) have been used in the construction of this outer structure.

The inside of this cup is lined with finer material like khus and other grass roots, coconut and other vegetable fibres, grasses, human and horse hair. Hume (1889 : 9) mentions finding wool and rags in addition to the above materials. Dewar (1929 : 27-28) writes of having come across pine needles, hard twigs and feathers, while Baker (1932 : 16) mentions a nest with the lining comprised of an old cap.

Coming back to the mode of construction, the actual construction of the outer cup and the inner lining is done by the female alone, the male only helping by bringing in suitable material. For the purpose of lining, wet or green vegetable material is sought probably for their flexibility; dry material is also collected and wetted before use. The female sits inside the nest and spends hours at a stretch fixing up the lining, and during this time the male brings in the required material. When supplies from the male are inadequate, both the partners make trips together.

Both the male and the female keep busy throughout the better part of the day bringing in material. There are interludes, of course, for meals, a little bit of love-making or a rest for a few minutes, in between the material-hunting trips. From observations made of 14 separate nesting pairs it appears that it usually takes an average pair about four to seven days for completion of a nest with lining and all.

The time factor appears to be directly proportional to the availability of the building material in the locality.

The finished nest is, generally speaking, a large (25-30 cm. diameter) shallow cup of sticks and twigs, roughly put together and occasionally containing metal strips and wires; the inner cavity is 12-15 cm. across and 7-10 cm. in depth, lined with roots, grass, vegetable fibres, animal hair, and other soft materials already mentioned.

Territory. The house crow does not seem to mind other members of the species building their nests in the same tree or as a matter of fact on the same branch. As many as nine nests are sometimes located in one large tree. To all appearances there are no territorial limitations and all birds, except birds of prey and the koel, are welcome to make use of the nesting tree in any way they think fit.

Laying and clutch size. The eggs are laid only when the nest is complete; sometimes a couple of days may lapse between the completion of the nest and the laying of the first egg. The female starts sitting in the nest from the time the first egg is laid. Four or five eggs are normally laid at intervals of twenty-four to forty-eight hours each; occasionally three (Dewar, 1929 : 27-28), and rarely six (Hume, 1889 : 9, Dewar, 1929 : 27-28) eggs, may be laid.

As much variation in the clutch size of this bird has been recorded by various workers in the past it will not, perhaps, be entirely irrelevant to mention here that the clutch size in indeterminate layers like this bird is conditioned by a number of ecological and physiological factors, details of which can be found in Lack's (1947) paper on the significance of clutch size.

The eggs vary a good deal in shape, size, colour, and markings. Typically the eggs are broad ovals pointed towards the small end, but pyriform, elongate, and globular varieties are commonly met with. The eggs are hard and fine in texture and fairly glossy. The ground colour is any shade of bluish green. All eggs are blotched, speckled and streaked with dull reddish brown, sepia, grey, and neutral tints. The shade and intensity of blotches, specks, and streaks vary a great deal in the various eggs and also in various parts of the same egg, usually near the ends. The size varies from 24-29 mm. × 33-40 mm.

Incubation. The incubation for the most part is done by the female. The male relieves her at intervals during the day when she goes out for food and a much needed outing. At night the female alone sits in the nest.

It will be interesting to remark here the reaction of the incubating birds to strange eggs and foreign objects appearing all of a sudden in the nest. Usually the nest is never left unattended. One of the birds mounts guard when the other is away and does not ordinarily leave the nest till the partner relieves him or her. But the sight of a koel in the neighbourhood or of a man climbing the tree on which the nest is located or another tree in the vicinity is too much for the crow to endure. Losing all self control it launches in sudden fury an attack all by itself or joins the mêlée of the brotherhood for an attack on the intruder, forgetting for a while its own eggs. It is probably in such unguarded moments of extreme excitement that it is deceived by a female koel or an experimenting ornithologist who seizes the opportunity of placing its eggs in the nest or replacing the crow's eggs by some other object (s).

Intelligent as the bird is, it is hard to believe that it does not notice the change when it returns. But it may react differently to the visit of the two intruders. After having noticed the man's approach and then the change in the contents of the nest, it may attribute the change to the visit of the man and may abandon the nest, with its contents. But such desertions are very rare ; in my experience they are not more than 5 per cent, presumably because the crow is not much afraid of man.

If the nest has been robbed completely it is sure to be deserted. If only a part of the contents has been removed or replaced, apparently no great notice is taken no matter how strikingly different the replacement may be. On several occasions I have removed one or two of its eggs and replaced them after painting them scarlet and brown with transparent photographic water dyes, and they have been accepted coolly. Thrice a crow accepted eggs of a jungle crow, twice of a common Myna and once a Paddy bird's added by ones and twos to its own clutch. It refused to incubate a full clutch replaced by Myna's eggs and another one by those of a Drongo, but readily accepted a jungle crow's clutch in replacement. It appears that this species accepts strange eggs and foreign objects if they resemble its own clutch or if one or more of its own eggs are left in the nest along with the replacements.

Period of incubation. By the period of incubation I here mean the time lag between laying of the last egg and the appearance of the last hatchling. Of the 20 nests watched at Vellore for the determination of the period of incubation, in fifteen the eggs hatched out after sixteen days of incubation, in two it took 17 days, in two the eggs did not hatch at all, while one was deserted on the 7th day.

It will be interesting to note here that, in the cases where the eggs did not hatch, the birds incubated for 27 days in one and 30 days in the other before giving up and finally deserting the nest.

At Poona on two occasions I collected crow's nests with eggs, for ectoparasite study, which according to my previous observations should have been incubated for more than a week. To my surprise they failed to show any signs of developing embryo on being opened; evidently the clutches were infertile.

All the eggs in a clutch, do not hatch, especially in clutches of five. Clutches of four and three hatch a comparatively larger percentage than those of five. At Vellore it was observed that of twenty-five eggs from five clutches of five eggs each, twenty (80%) hatched, of thirty-two eggs from eight clutches of four eggs each twenty-eight (87.5%) hatched, while all the 12 eggs (100%) from four clutches of three eggs each hatched out.

The young in the nest. The young hatch out one after the other, at intervals of twenty-four to forty-eight hours. The newly hatched young, like other nidicolous young, are entirely devoid of nestling down. They are unable to stand up and lie helplessly on their delicate and almost transparent abdomens. The body is light flesh coloured. The eyes are closed. The beak and claws are soft and fleshy, and are of the same colour as the rest of the body. The Neossoptiles make their first appearance between forty-eight and seventy-two hours after hatching. They consist of prepennae which are duly replaced by regular contour feathers. The remiges and rectrices appear in the second week and look like gramophone needles at first. Then a tuft of hair-like feathers (barbs) appears at the needle point. At this stage, with elongated shafts and tufts of hair at the distal end, they resemble miniature artists' brushes arranged in rows of uneven sizes. The tuft gradually elongates into rachis and vane while the shaft ultimately forms the calamus. By the end of the fourth week the young are fully fledged. The colour of the plumage of the fully fledged young is similar to that of adult bird.

Apparently the freshly hatched nestlings are not fed, or rather are not able to accept food, till about 24 hours after their emergence from the shell. Some time between forty-eight and seventy-two hours their eyes open and by that time the feeding of the young by the parents is in full swing. Both parents bring food and feed the young. One of the parents is always around during the early days to guard them from predators, to warn them, or to protect them from the hot sun or a light shower of rain, while the other is hunting food for them.

Just as all the eggs that are laid do not hatch, all the young ones that hatch out do not live to leave the nest as will be seen from Table I.

Table I

MORTALITY IN FLEDGLINGS OF THE HOUSE CROW *Corvus splendens*

Nest No.	No of eggs laid	No. of fledglings hatched out	No. of fledglings flew out of nest	No. of fledglings died
1	4	4	3	1
2	5	5	3	2
3	4	4	4	0
4	3	3	3	0
5	5	4	2	2
6	4	4	3	1
7	4	3	3	0
8	3	3	2	1 (1 Koel present)
9	5	3	3	0
10	4	Nest deserted		
11	4	3	2	1
12	3	3	3	0
13	5	4	3	1
14	4	Nest deserted		
15	4	4	2	2
16	4	3	3	0
17	5	4	3	1
18	4	Nest deserted		
19	3	3	1	2 (1 Koel present)
20	4	3	1	2 (1 Koel present)

The majority of deaths occur in the first week. Most deaths amongst the young ones of the crow are due to want of food. It is rarely due to a chance fall from the nest or as a result of some marauder's attack. Although the birds keep bringing in food from dawn till dusk they cannot usually meet the full demand of a clutch of five, and sometimes even of four, nestlings who, for the first few days, are supposed to consume more than their own weight of food; unless, of course, there is abundance of food in the locality, in which case they do get around to the feeding of all the five or four of the clutch satisfactorily. When the fledglings are very young, the parents seem to make no discrimination whatever, in feeding them. The parent on arrival at the nest with bill full of food is confronted with a number of gaping mouths as each of the nestlings raises its neck and gapes widely. The parent stuffs the food into one of the gaping mouths, probably that which happens to be the nearest, until the food it has brought is finished, or the chick is unable to swallow any more; in such cases what remains is pushed down another throat. This is repeated at every visit by the parent. The young which are not fed until their stronger brethren have received all they can take start losing ground with the passage of time, and soon become so weak that they cannot even raise their necks to demand food. The parents do not seem to take any notice of such weaklings, and certainly do not make any special attempts to feed them. The weakest thus go to the wall. The dead are thrown out by the parents without the slightest concern. Most such deaths occur during the first week and very rarely during the second week.

The nestlings who survive the critical early phase in the nest remain there for three to four weeks, closely guarded and devotedly fed by the affectionate parents. A three-to-four-week-old nestling is fully fledged and can fly short distances if forced to do so. After leaving the nest they stay around in the branches of the nesting tree where they are fed by the parents. Later they stay close to the parents for a few weeks, usually the mother, and follow her wherever she goes. As soon as she picks up a little bit of food the demand by the young one starts. It opens and shuffles its wing and presents a gaping bill to be fed. Generally the mother transfers the morsel to it.

Nesting success. By nesting success I mean here the ratio of the fledglings that flew from the nest to the number of eggs laid. As already indicated the nesting success in crows depends on many factors, the most important ones being the amount of food available for the young at the nesting stage, the fertility of the eggs laid, and interference by parasites (koels) and predators (including man). In the present study a total of eighty-one eggs were laid in twenty nests. A total of forty-four young excluding the three koel fledglings left the nest. It roughly works out to fifty-four per cent.

Parasitising by the Koel [*Eudynamys scolopacea* **(Linnaeus)**]. Coming back again to the subject of deceiving the clever crow, none can beat the

Koel *Eudynamys scolopacea* (Linnaeus). This species of parasitic cuckoo, whose breeding season happens to coincide with that of the crow, has decided to entrust, rather thrust, the responsibility of a part of her own domestic duties to this crow, and has made the crow its main host.

The crow, not liking to be exploited, guards its nest all the twenty-four hours, but the mere sight of a koel prompts it to leave its nest and chase the koel. Knowing this weakness of their victim the male and female koels seem to have worked out a clever bit of a strategy. When the female koel is ready to lay, the male flies up to the crow's nest and makes himself known by emitting loud notes. The very sight of him infuriates the crow, who is usually incubating alone. Leaving the nest unguarded the crow attacks the koel, who turns tail the moment the owner or owners of the nest go for him. Being a better flier the male koel manages to keep only a little ahead, thus encouraging the crows to chase further and leads them away from the nest. The female koel who sits hidden, watching the proceedings, then takes possession of the deserted nest and relieves herself of her egg. She then flies away emitting a shrill *kuil-kuil-kuil,* apparently to tell the male that the strategy has been successful. The male then shakes off the pursuers and proceeds at full speed to join the female. Sometimes, however, things go wrong and the male or the female koel is caught red-handed and punished for its crimes by the indignant crows. I have myself seen and there are instances on record (Butler, 1876, quoted by Hume, 1889) when koels have been mauled by an angry mob of crows.

Usually only one egg is laid by the koel in one nest. Sometimes, however, more than one koel's egg may be found in crow's nest (Jacob, 1915 ; Jones, 1916 ; Abdulali, 1932[1] ; Burton, 1935); probably, they are the produce of more than one bird. It is difficult to say whether or not the koel destroys one of the crow's eggs, when she lays one of her own in its nest. To all appearances she does not (Dewar, 1907). A koel leaving a crow's nest with an egg in its beak is yet to be seen.

Meanwhile the crows, pleased with themselves for having successfully driven away the treacherous koel, return to their nest only to be confronted with a strange egg lying amongst their own. Whether they recognise it or not is a controversial question, but the fact remains that the crows neither desert the nest nor try to throw out the koel's egg.

The koel's egg has a superficial resemblance to that of a crow but it is smaller and has a green ground colour instead of blue. The green may be olive, sea-green, or almost stony colour. The texture is compact and fine and is entirely devoid of gloss. It is speckled, spotted,

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[[1] The nest contained 11 koel eggs and none of the crow.—EDS.]

streaked and clouded with brown, or red or purple tint. The average size is 30 mm. in length and 23 mm. in breadth.

The koel's egg (or eggs) is (are) hatched along with (its) their own by the crows in the most matter of fact way. The period of incubation for koel's eggs as observed during the present study in three cases was 13 days. The young koel usually hatches a little before its foster brethren and hence has a little start on them. The freshly hatched koel like the young one of all other nidicolous species is blind, pinkish red in colour, entirely devoid of down or feathers, with a very soft and fleshy beak and claws. But for its zygodactyl claws it could easily pass for a crow fledgling. The crows do not appear to see this difference, and feed it in right earnest, even before any one of their own eggs is hatched. The young koel seems to have an insatiable hunger and greedily devours large quantities of food brought by the foster parents. By the time the young crows hatch out, it is usually big and strong enough to attract the greater attention of its foster parents by stretching out its neck towards them as they come in with food, and thus obtains a greater share of it. The great hunger of the koel nestling tells on some of the young crows, who fight a losing battle in the struggle for existence in the nest and perish. All but one, sometimes two of the young crows die for want of food if their nests include a koel nestling. Twice I have collected crow's nests at Poona, with only two koel fledglings, about three weeks old and no crows. As the brood size is limited by the feeding capacity of the parents (Lack, 1947) I am inclined to believe that the young crows in those nests could not compete with the two koels.

The young koel is usually the healthiest occupant of the nest. It acquires its feathers faster than its foster brethren. The plumage is uniformly black spotted with white all over the body, wings, and tail. It is still in this plumage when it leaves nest and when it finally takes leave of its foster parents. It leaves the nest along with and about the same time as the young crows, provided there are any left. The crows continue to feed it even after it has left the nest. On many occasions I have seen crows paying more attention to this foster child, whose demand for food never ceases, than to their own. The procedure for asking for food is the same as that of young crows. Although not well adapted for terrestrial movement, after leaving the nest it often alights on a stone or boulder to demand food when the foster parents are feeding on ground.

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Additions to the Flora of Bombay State : Grasses from Salsette Island (Malad-Madh Area)

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Lisboa (1891), Cooke (1908), and Blatter & McCann (1935) described the grasses of the Bombay Presidency. Santapau (1950, 1953, and 1957) enumerated the grasses from Saurashtra, Khandala, and Purandhar. We add the following grasses which are recorded for the first time for Bombay State. The herbarium specimens referred to herein, with the collectors' names and numbers, are deposited in Blatter Herbarium, St. Xavier's College, Bombay.

The authors are deeply grateful to Dr. N. L. Bor, Kew Gardens, England, for their identification.

Digitaria adscendens (H.B.K.) Henrard ssp. **chrysoblephara** Henrard, Mon. Gen. Digitaria 998, 1950; Bor 299.

Annual herbs; stems glabrous, simple or branched, 45-60 cm. tall, ascending from a geniculate base or prostrate, rooting at the lower nodes. Leaf-blades 5.5-20×0.6-1 (15×0.8) cm., hairy, flat; sheaths 3-6 cm. long, glabrous or sparsely hairy. Spikes 4-10, 6-15 cm. long. Spikelets 2-3-nate, closely appressed to the wavy or nearly straight, somewhat winged rachis.

Collected from Madh Island, along roadsides (*Fernandez* 2082, 2084, 2086-87).

Spikelets: September.

World distribution: Tropical Africa and in tropical Asia from India to China and Japan.

Digitaria timorensis (Kunth) Bal ssp. **blepharophora** Henrard, Mon. Gen. Digitaria 747, 1950.

Annual herbs; culms tufted, simple or branched from the base, erect or ascending, 45-60 cm. tall, deeply striate, glabrous, at times rooting at the lower nodes. Leaves 12-20 cm. long, linear-lanceolate, glabrous or sparsely pilose above, somewhat scaberulous on the margins; sheaths 4-11 cm. long, somewhat compressed, glabrous or more or less pubescent, at least the lower ones. Racemes 6-8.5 cm. long, secund, spreading, digitate. Spikelets 2.5-3 mm. long, very narrowly linear-lanceolate, on a flattened, narrowly-winged, green, glabrous rachis. Glume III (sterile lemma) glabrous between the broad central interspaces along the mid-nerve, apparently 3-nerved, the indistinct marginal nerves double and not conspicuous in front; margins provided with a row of crateriform protrusions from which arise long, stiff, yellowish, spreading bristles which are as long as or longer than the diameter of the spikelets; between them there are moreover soft, shorter common hairs. Fruit about as long as the spikelet, very narrowly lanceolate.

Occasionally found along roadsides (*Shah* 714 is the only sheet of this plant in Blatter Herbarium).

Spikelets: November.

World distribution: For the distribution Henrard writes: 'Hitherto only known from Timor'. We add locality 'Bombay' from India.

Eragrostis tef (Zucc.) Trott. in Bull. Soc. Bot. Ital. 62, 1918 in Obs.; Bor 513. *Poa tef* Zucc. Diss. Ist. Pianta Panizz. Abiss. 1774.

Annual herbs; about 40 cm. tall; culms tufted, slender, striate, glabrous, pale-green, erect or geniculately ascending from the short creeping base, simple or branched in the lower part; nodes glabrous. Leaf-blades 4-10 (6.5) cm. long, very narrowly linear or almost subulate, erect or spreading, flat or convolute, many-nerved, central mid-rib prominent, glabrous, setaceous, acuminate at the apex, somewhat contracted and subrotund at the base; sheaths 3.5-7 (5.5) cm. long, tight, close-fitting, glabrous, striate. Panicles 15-20 cm. long, open; branches almost filiform, erect, straight or slightly wavy. Spikelets about 2-4 mm. long, olive-green or greenish-purple, ovate, laterally compressed, pedicellate, glabrous. Florets 4-6 or more, exserted from the glumes. Glumes membranous, 1-3-nerved. Lemmas about 1.5 mm. long ovate with a short acumen, membranous, 1-3-nerved; when 3-nerved, the central nerve prominent and somewhat keeled on the dorsal side. Palea about 1 mm. long, hyaline, prominently 2-keeled. Stamens 2. Caryopsis oblong, brown, shorter and enclosed by the lemma and palea and falling with the lemma only.

Rare in the district; noted only once along roadsides (*Shah* 696). According to Bor, the plant is a native of Ethiopia, introduced in several parts of the world.

Spikelets: September.

Critical notes: This plant so far is not recorded in any of our Indian floras; however, Bor cites two sheets of this plant from India: (1) *J. S. Gamble* 21404 Nilgiris and (2) *J. F. Duthie s.n.*, north India. We add the locality 'Salsette Island, Bombay'. Our collection is the only sheet of this plant in Blatter Herbarium.

Isachne dispar Trin. Sp. Gram. Icon. t. 86, 1828; FBI. 7 : 26; Bor 580.

Annual herbs; 15-40 cm. tall; culms spongy, somewhat polished, glabrous, prostrate, rooting at the nodes and then geniculately becoming erect. Leaf-blades 2.3-6.5×0.4-1 (4.5×0.6) cm., ovate to lanceolate, flat, rather stiff, striate, scaberulous; apex finely acute or acuminate; base subcordate or rounded; upper leaves sometimes sparsely hairy at the base; margins minutely scabrid and thickened; sheaths 1.8-3.5 cm. long, smooth, shining, striate, glabrous, hairy at the mouth. Panicles 1.5-5 cm. long, pyramidal and open, or contracted and ovoid. Spikelets about 1 mm. long, green or purple, obtuse, pedicellate, smooth and polished.

Common along water ditches and in moist ground (*Shah* 7669, 8622).

World distribution: India (western Peninsula, Assam, and North-West) and China.

Critical notes: This plant is very similar to *Isachne globosa* O.Kuntze; the two are common and often grow together in moist ground and water-logged soil. For *I. dispar* Trin. Hooker in FBI. 7 : 26, 1896 writes in the note: 'This again is perhaps a variety of *I. australis* R. Br. [=*I. globosa* O.Kuntze] of low stature, with more rigid scaberulous strongly margined leaves, sometimes ciliate at the base and smaller panicles with shorter pedicels'. Bor distinguishes the two species as follows:

Panicles lax; leaf-blades narrowly lanceolate;
pedicels with glandular bands ... *I. globosa*
Panicles dense; leaf-blades ovate-lanceolate ... *I. dispar*

There are some sheets of this plant, identified by Dr. Bor, in Blatter Herbarium from Khandala, Dangs, Saurashtra, and Mount Abu; it seems the plant is common in Bombay State. Santapau does not give this plant (1950, 1953).

Oryza rufipogon Griff. Notul. 3 : 5, 1851; Bor 605. *Oryza fatua* Koen. ex Trin. in Mem. Akad. Petersb. (VI) 2 : 177, 1839 nom. nud. *Oryza sativa* L. var. *fatua* Prain, Beng. Pl. 1184, 1903. *Oryza sativa* var. *rufipogon* Watt, Dict. Econ. Prod. Ind. 5 : 504-05, 1891.

Annual herbs, 60-90 cm. tall; culms soft, glabrous, pale-green, spongy below. Leaf-blades 15-30×0.8-1.2 (20×1) cm., linear, flat, acuminate at the apex, scabridly hairy on both surfaces; sheaths smooth, glabrous. Panicles 8-20 cm. long, effuse, at first erect, at length nodding. Spikelets 7-8 mm. long, pale-green, drying pale-brown, scabridly hairy; hairs whitish; awns 4.5-8 cm. long, coarsely scabrid, pale-brown, polished.

A common, abundant and gregarious, marshy grass, often forming large patches in shallow water-ditches (*Shah* 702, 4992, 7825).

Spikelets: September-October.

Local name: Dev-Bhat.

World distribution: India, Ceylon, Burma, Malaya, Indo-China, Indonesia, and Thailand. *Type loc.:* India.

Critical notes: This plant is not given by Cooke and Santapau. Blatter & McCann treat it as a synonym of *O. sativa* L., to which it is closely related. However, the two species can be separated as follows:

Spikelets persistent awned or awnless	...	*O. sativa*
Spikelets caducous, always awned	...	*O. rufipogon*

Paspalum orbiculare Forst. Fl. Ins. Austr. Prodr. 7, 1786; Bor 340.

Perennial herbs; culms 30-45 cm. tall, loosely tufted, branched near the base, erect or ascending from a somewhat geniculate base, deeply striate, glabrous, terete above, slightly spongy below; nodes glabrous, dark-brown. Leaf-blades 5-10×0.2-0.6 cm., linear or sublanceolate, glabrous; margins involute, glabrous or minutely scabrid or scarcely rough, finely acute or acuminate at the apex, somewhat contracted at the base, densely hairy behind the ligule; sheaths 4-6 cm. long, compressed, persistent, striate, glabrous or hairy, with scarious, glabrous, or ciliate margins. Spike-like racemes 4-5 cm. long, solitary or subdigitately paired, erect, closely appressed or spreading. Spikelets many, about 2 mm. long, biseriate, plano-convex, yellowish-brown, glabrous and polished, much imbricating, ovate-elliptic, broadly ovate or orbicular; lower floret sterile, upper one hermaphrodite; upper glume and lower lemma 3-nerved, subcoriaceous or subcrustaceous, punctate, polished. Stamens 3.

Rare; noted only once along margins of a pond on Madh Island (*Shah* 7191).

Spikelets: August.

World distribution: Forster described this plant from Society Islands; now distributed in the tropics and subtropics of the Old World but in tropical Asia rarer than *P. scrobiculatum* L. Bor

(p. 340) writes: 'south-east Asia generally, but not found in north-west India, Central India, or Bombay, extending to Polynesia and Australia'. We add locality Bombay.

Critical notes: Our collection is the only sheet of this plant in Blatter Herbarium and so far it has not been collected or reported by any previous worker from Bombay State.

Paspalum orbiculare Forst., and *Paspalum scrobiculatum* L. occur in the present area; they apparently look very similar and are liable to be confused. Hook. f. in Fl. Brit. Ind. 7 : 10, 1896 treated *P. orbiculare* Forst. as a synonym of *P. scrobiculatum* L. Stapf. (Fl. Trop. Afr. 579, 1919), and Bor (Fl. Assam 254, 1940 and Mon. Grasses p. 340) considered the two species as distinct. For *P. orbiculare* Henrard (Blumea 3 : 440, 1940) remarks: 'In this specimen the small green spikelets are distinctly apiculate and not rounded at the summit as is the case in *P. scrobiculatum* L. and both glumes are 3-nerved. We are thus able to separate this species which occurs rather plentiful in Lingga Archipelago.' Rheder (Journ. Arn. Arbor. 29 : 300, 1948) writes for the present plant: 'Readily distinguishable from *P. scrobiculatum* L. by its 3-nerved glume and sterile lemma and its usually more numerous racemes which are distant on the axis.' The following is the key to separate the two species:

Annuals; upper glume and lower lemma 5-7-nerved; spikelets obtuse or rounded at the apex ...	*P. scrobiculatum*
Perennials; upper glume and lower lemma 3-nerved; spikelets distinctly apiculate ...	*P. orbiculare*

Setaria pallide-fusca (Schum.) Stapf. & Hubb. in Kew Bull. 1930: 259; Bor 363. *Panicum pallide-fuscum* Schum. Beskr. Guin. Pl. 58, 1827.

Annual herbs; 30-60 cm. tall; culms tufted, slender, glabrous, geniculately ascending from a short base. Leaf-blades 3.5-25 (15) cm. long, linear, flat or folded, glabrous or slightly hairy towards the base; apex finely acuminate; base rounded; sheaths glabrous, lower ones somewhat compressed, upper terete. Spike-like panicle 5-12 (8) cm. long, erect, cylindric, continuous, densely flowered. Spikelets 2-2.5 mm. long, on slender rachis; bristles mostly rufous, rarely purplish.

Common in open grass lands on hills (*Shah* 33, 109, 704, 7278).

Spikelets: July-September.

World distribution: From tropical and south Africa to tropical Asia, northern Australia and Polynesia. *Type loc.:* West Africa.

Critical notes: This plant is recorded here for the first time from

Bombay State. It is very similar to *Setaria glauca* (L.) P. Beauv. and the two are likely to be confused. Both the species are purely monsoon plants; they are common, abundant, and often gregarious, in pure stands or mixed together. The large patches of these plants, with their reddish-brown spikelets, especially by the end of monsoon, are conspicuous along roadsides, railway lines, in open grass lands on hills, etc.; occasionally they have also been noted on walls.

The two species are distinguished as follows:

Spikelets 3 mm. long; upper lemma coarsely rugose, boat-shaped and slightly keeled upwards, broad and dorsally strongly curved on the back in profile ... *S. glauca*

Spikelets 2-2.5 mm. long; upper lemma finely rugose, narrow and dorsally gently curved, not at all keeled ... *S. pallide-fusca*

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New Breeding Records of Malayan Birds

BY

J. CAIRNS, M.C., M.B.O.U.

(*With three plates*)

Family ARDEIDAE

Cattle Egret : **Ardeola ibis coromanda** (Boddaert)[1]

Having discovered in 1956 and reported in the *Malayan Nature Journal*, December 1959, **13** (2) : 92, a breeding colony of Little Egrets, *E. g. garzetta*, in Perak, I had for a long time before this felt convinced that the Cattle Egret, *A. i. coromanda,* also bred in Malayan territory. This conviction was based on my own records of cattle egrets wearing their full regalia of breeding plumes while present in Penang right through April, May, and into the first week of June, after which they vanished. Eventually, however, when I did find them breeding it was a long way from Penang. This was in mid June 1959 in Kelantan, when on my way to revisit the pratincole colony discovered the previous year. I first noticed a few egrets around a group of the smallish black buffaloes which are a characteristic feature of Kelantan landscapes. Six birds were visible and all had golden plumes. The area was seared by the sun, miles inland from the coast, and the birds were simply following the meandering buffaloes. The date being 16 June gave me reason to hope that they might be mates of brooding birds; or if not already nesting they probably intended doing so. Therefore, I devoted the day to watching them. Great stretches of flat land in three directions lacked limitless vistas due to numerous 'islands' of mixed trees irregularly scattered over it, thus conveying a distinct sense of contraction and interrupted horizons. In the afternoon, after having noted numerous flights to and from one particular 'island' about half a mile (*c.* 1 km.) distant, I headed directly towards this objective and there ultimately found a colony.

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[1] Nomenclature as in AN ANNOTATED CHECKLIST OF THE BIRDS OF MALAYA (C. A. Gibson-Hill, 1949).

There were ten nests in thinly foliaged fringe trees along a frontage of twenty yards (*c.* 18 m.) facing east. The lowest and highest of these nests were 8 and 18 feet (*c.* 2 and 5 m.) respectively, and the remainder between 12 and 15 feet (*c.* 4 and 5 m.) high. Their ragged loosely constructed appearance from the ground was an illusion as I soon discovered on close inspection, when I was surprised by their compactness and solidity. Exterior diameters averaged around 16 inches (*c.* 40 cm.); interiors were spacious and deeper than expected and had no lining other than rootlets and broken twigs. Eight nests contained eggs: two with four, three with three, two with two, one with one, while two nests were empty. The eggs had smooth glossless texture and unique colour—uniform pale milky blue—with no trace of heron green. Average measurements of the twenty-two eggs were: *c.* 45×35 mm. At least half of the bill and end of the tail of an incubating bird projected over the nest rim. I made a complete circuit of the 'island' and then went through it in two directions but saw no trace of old nests, and so concluded that this present colony was freshly established, although in all probability it had been sited at other 'islands' in other years. At any rate, this prosperous nucleus of beautiful birds was flourishing again in 1960, but since then I have not been back.

Tiger Bittern : **G. melanolophus melanolophus** Raffles

Compared with the small bitterns the Tiger Bittern is considerably longer [20 inches (*c.* 50 cm.)], rounder, and as a breeder in Malaya very much rarer. In forty years I have seen four nests: October 1923, September 1931, August 1941, and September 1953—the first two in Penang, the third in Province Wellesley, and the last in Kelantan. The salient features of this shy and solitary bird are its plumage, its bill, and its nest. The adult has a black crest projecting beyond the back of the crown to the nape; the sides and back of the neck are rufous; the back, mantle, and wings are cinnamon, with close stipplings of black; some primary coverts and primaries are black with touches of white at the tips. The upper side of the tail is oily black, the underside white. The whole of the underparts from throat to vent may be described as ochreous yellow, streaked, barred, and mottled with black, and the impact on the observer is very striking. In addition, the bird has a noticeably thick, slightly down-curved green bill with a black tip, more like that of a gallinaceous bird than a heron. The 1923 nest was placed in the summit of a dense reed bed mixed with scrub a little less than 7 feet tall, and was made of stiff reed stems and twigs with a lining of dried iris flags and water hyacinth leaves.

The others, however, were high up in trees constructed entirely of sticks and lined with dead leaves. The 1953 nest was highest of all, 60 feet (*c.* 18 m.) up in a mangrove tree (Kelantan River estuary, in the vicinity of Tumpat). Each nest when found contained four eggs, but although the tree nests were definitely in the heron-type category, excepting of course the leaf-lining, the eggs were very definitely not, being slightly pointed at both ends and pure mat-white. The average measurements of sixteen are *c.* 49×39 mm. The birds fed habitually by day during the nesting period.

Schrenck's Bittern : **Ixobrychus eurhythmus** (Swinhoe)

Schrenck's Bittern [length 12 inches (*c.* 30 cm.)] is the smallest of the three small Malayan bitterns, the two others being the Yellow (*I. sinensis*) [length 14 inches (*c.* 35 cm.)], and the Chestnut (*I. cinnamomeus*) [length 15 inches (*c.* 38 cm.)]. At a glance Schrenck's might be mistaken for the Chestnut, but there are two features which distinguish it at once. Generally speaking the Chestnut in flight is uniformly chestnut over all its upper surface, whereas Schrenck's is chestnut with blue-black wing primaries and tail. The Chestnut and the Yellow are resident breeding birds and, although the Yellow and Schrenck's stand in official records as winter visitors only, Schrenck's also breeds but is not resident. Full accounts by me of the breeding of the Chestnut and the Yellow Bitterns have been published (vide *Malayan Nature Journals* 1941 and 1954) but hitherto the breeding of Schrenck's has not. The latter, of course, is the rarest of the three and can easily be missed or its identity mistaken as cited above. However, over many years of field work amongst bitterns, and long before I got a nest, I noted it occurring more frequently than it was supposed to do. My first nest was found on 7 July 1941. It was composed of living herbage bent over and interlocked to form a substantial pad about 2 feet (*c.* 60 cm.) above ankle-deep water in dense reeds (*Scirpus grossus*) at the corner of a paddy field. Lined with dry menerong (*Scirpus grossus* blades) it contained three eggs on the point of hatching. So began an irregular series of odd nests all on Penang Island, the most recent one occurring in August 1961. These comparative factual observations may be useful: Nests of Chestnut Bitterns are large open platforms at water level; nests of Yellow Bitterns are domed suspended small pads from 3 feet to 6 feet (*c.* 90 to 180 cm.) above water level; nests of Schrenck's Bitterns are open supported small pads usually about 2 feet (*c.* 60 cm.) above water. Again, Chestnut Bittern eggs are broad chalky white ovals averaging *c.* 34×27 mm.; Yellow Bittern eggs are smooth pale green ovals averaging *c.* 32×24 cm.;

whilst Schrenck's Bittern eggs are smooth creamy-white ovals averaging *c.* 30×23 mm.; each a thin-shelled distinctive type. When clearing land for paddy planting Malays come across many bittern nests and gather the eggs for food. On several occasions in different years I have seen the eggs of all three species being carried home in coconut shells and other receptacles, which means there must be more nests of Schrenck's Bitterns about than those now recorded.

Family ANATIDAE

Cotton Teal : **Nettapus coromandelianus coromandelianus** (Gmelin)

This small resident duck is also something of a phenomenon. It is known from every Malay State, yet no breeding has ever been reported which, to say the least, is quite extraordinary since a resident bird must breed regularly. It is a fact, however, that I have never found them breeding in the same place in consecutive years, although all such places are secluded and remote. In addition, as soon as egg laying begins the birds become completely silent so that seclusion and silence may have some bearing on the lack of information. First nests were found in Kedah in September 1947. There were five within the area of a small backwater surrounded by secondary forest. Two of these were placed in a reed bed and three were in hollow tree-limbs projecting over the reeds. The open nests were made entirely of dried reeds lined with down and the whole wedged into and supported by the densely growing stems. The tree nests were made entirely of down, creamy with dusky centres, sparingly mixed with slivers of dessicated herbage. The reed nests contained six (eventually ten) and nine eggs respectively, while the contents of the tree nests were seven, eight, and eight. Near Chalag, Kelantan, in September 1950, I got one tree nest containing eleven. The eggs are smooth ivory-white ovals averaging *c.* 43×32 mm., which is somewhat smaller than the cream-shelled eggs of the Whistling Teal, *D. j. javanica.* According to my observations only the duck incubates. The drake is a striking bird; bill black, crown and nape dark brown; face, neck, and all underparts pure white with a broad black collar round the base of the neck. Back and wings shiny green-bronze with white wing patches very noticeable in flight. The duck's face and neck are grey with no collar. Her back is brown, breast grey, flanks tinged with buff, belly dull white. The male looks like a pigmy goose and his peculiar voice is a goose-like gabble in minor key. In November 1956 a Malay fisherman with whom I had contact for many years sailed his *prahu* all the way from Port Weld to Penang to tell me he had found some ducks' nests in mangrove forest! *Itek belabas* he called them, which is the Malay name for Cotton Teal, and at the same time handed me a small basket containing three eggs. Next day we started the long trip back to Port Weld. Eventually I was taken to the place and saw six nests of Cotton Teal wedged into the mingled arches of mangrove roots in old forest. Three adjacent trees were involved in supporting the little colony. On our approach I noticed that all the disturbed birds flew inland and not seawards. The nest from which the three eggs had been taken still contained three, so that the clutch in this case had been six when found. Two others held nine each, and three held ten each. The principal breeding period appears to be September through to December, but characteristically the bird and the month and the place are unpredictable.

Family ACCIPITRIDAE

Bat Hawk : **Machaerhamphus alcinus alcinus** Westerman

9 November 1959 was bright blue and sunny. At 9.30 a.m. of that day I happened to be in a remote area of Penang Island when a large black falcon-like bird passed overhead with what appeared to be a snake but was in reality a small branch dangling under its body. Through my glasses I followed the bird to its destination, which was a tall tree on the edge of swamp backed by forest about 400 yards (*c.* 365 m.) distant. Moving inside the forest fringe to within 20 yards (*c.* 18 m.) of the tree I discovered that the bird was none other than a splendid Bat Hawk or Pern, *M. a. alcinus*, serenely employed in shaping the foundation of an eyrie. From that day on I learned some new facts concerning the habits of Bat Hawks, supplementing the meagre known ones. Because of its appearance the species is quickly and easily identified. In the field it shows entirely black with conspicuous white throat and central breast. A closer look reveals white patches above and below the eyes and a long black crest down the nape. The bill is black and the legs and feet are reddish black with black claws. Through the four weeks following, nest building by both birds was a daily routine, especially between 9 a.m. and noon, but if it rained all such activity ceased. Longish flights were taken to collect material usually in one direction, which might or might not indicate preference for certain sticks. At any rate it is to be noted that, although the birds are definitely crepuscular in habit when feeding, as I will soon describe, the entire nest was built during the

brightest part of 28 consecutive days and at no time did the birds show any sign of embarrassment or distress through the dazzle of tropical light. Flight was swift and sure at all times and no different from the feeding flight at dusk. After 9 December no more material was collected and for the next 7 days both birds perched close to the nest several times daily, but between these visits disappeared altogether. The nest was a fair-sized structure of sticks, which looked smaller than it actually proved to be, due to its being sited a short way out on a limb in a bower of foliage, and could only be wholly seen from directly below. On 16 December my climber made his first ascent which presented no difficulty. The nest was empty. It measured 1 foot (*c.* 30 cm.) high and 2 feet (*c.* 60 cm.) wide with a shallow central depression 1 foot (*c.* 30 cm.) across. The lining consisted of fine roots and fibres but no leaves. Height from the ground was 110 feet (*c.* 33 m.). The fineness of the sticks comprising the upper exterior structure gave a close-packed effect suggestive of a squirrel's drey. At 10 a.m. on 17 December there was one egg in the nest and one spray of green leaves. At 10 a.m. on the 18th there was no change. At 10 a.m. on the 19th there were two eggs and three green sprays. On the 20th, no change. At 10 a.m. on the 21st there were 3 eggs and 5 green sprays. This proved to be the complete clutch and, as shown, egg-laying occurred on alternate days. Individual measurements of the 3 eggs were: *c.* 63×47, *c.* 60×46, *c.* 61×47 mm., giving an average of 61×47 mm. All were smooth, without gloss and blue-white in colour, yet each egg was different. The largest was unmarked blue-white, the second largest had submerged clouding of pale grey, whilst the smallest, also clouded with pale grey, had in addition pale red freckles sparingly sprinkled over the small end. This egg was laid first and the largest last. Nesting on one previous occasion is on record but the nest and eggs were not examined or described. The Bat Hawk's method of hunting is fascinating; and over a period of months I never saw either bird chase or catch anything other than bats. Invariably about 6.50 p.m., the bat-echelons in depth began their erratic coursing, always north to south, past the Hawk's tree and, strange to relate, the bird on watch never attempted to interfere with these first flights. When attacks did begin, however, they were continuous and amazingly successful. On several evenings, no less than seven bats were caught and devoured in 12 minutes by the same bird. The captures were not made by power dives from above like a Peregrine; the Bat Hawk always flew level with and straight through the flank of advancing bats, then curved up under its victim, and in one simultaneous movement turned on its back, reached upward with its talons, and literally plucked the bat out of the air, before swerving away into normal flying position. Bats so caught were often devoured piecemeal in the air at once or just as frequently after flying back to the favoured perch. When consumption occurred in flight I was able to observe that some part of the bat was always dropped—wings, I think—but this was not definitely established. Another remarkable fact was noted; the hawk at no time ever flew into a flock of bats to chase them indiscriminately. Every sally out of the tree was fast and straight towards what was quite evidently a pre-selected bat and all others were ignored. How and why this selection was made I cannot even remotely determine; and the solution will no doubt continue to remain as elusive as this very elusive bird.

Sparrow-Hawk : **Accipiter virgatus** (Temminck)

In any year in all kinds of country Sparrow-Hawks are frequently encountered from October through to April. Presumably these birds are members of the Japanese race, *A. v. gularis,* and regular winter visitors to Malaya. The existence of a resident race, however, has long been suspected but definite status never established. In view of this the finding of a Sparrow-Hawk's nest in Malaya becomes an important ornithological record. On 26 May 1957, in mountain forest east of Selama, Perak, I found one containing 3 eggs. My first glimpse of the bird as it flashed out of the tree made me think it was some species of cuckoo, but on hearing its voice I knew it was a Sparrow-Hawk. The alarm consisted of a querulous phrase of six notes, *keh-keh-keh-keh-ki-kee,* exactly to the time and accent of the song 'Ta Ra Ra Boom De-Ay' uttered in quick time. It was this call that encouraged me to expect a nest, since migratory birds rarely break silence when disturbed. Examining the tree from various ground positions I eventually spotted what appeared to be something denser and darker than a mere mass of foliage, sited on a horizontal bough where it branched into a treble fork about 8 feet (*c.* 2 m.) out from the main trunk; and when measured later found to be 65 feet (*c.* 20 m.) up but still well below the canopy. Changing to ×15 binoculars I could see a few flecks of white down and so knew the answer. On instructions my Malay climber went on up beyond the bough and looking down, reported three red-marked white eggs in the shallow centre of a structure of fine sticks about 18 inches (*c.* $\frac{1}{2}$ m.) wide. Although the nest was surrounded by green foliage no leaf, green or brown, or lining material of any kind was used in the fabric. Tufts of white down flecked the inner and outer perimeters: and all was fresh and new, indicating that the hawks had completely built their own nest and not used any older relic as a foundation. Next day 27th I got a good long look at the female preening on a bough some 10 feet above her nest. The head was dark grey; wings, back, and tail earth brown marked with darker brown. The throat was white with a dark vertical line in the centre. The breast and abdomen were off-white barred with medium strength brown. The under tail coverts were white; the iris, cere, and legs yellow tinged with green; and the beak was blackish grey. From her behaviour it was evident the clutch was incomplete. On examination my climber again reported three eggs, but as sparrow-hawks lay on alternate days the clutch, as shown later, was incomplete. Awang lowered the eggs in a basket for inspection. All were bluish white, unglossed, richly splashed with dull red. One had a claw hole at the side and this I retained. Individual measurements were: 39×30, 39×30, 40×31 mm.

Counting in reverse the third egg must have been laid on 26 May, the second on 24 May, and the first on 22 May. After the two eggs were hoisted back to the nest the male appeared. He was uniform grey above including the tail which had four bars across it. The throat, central belly and undertail were cream while all remaining underparts were very rich rufous without bars. The bill appeared to be black and the tarsi an impure yellow. I judged him to be a foot (*c.* 30 cm.) in length and the bulkier female about 15 inches (*c.* 38 cm.). On the 28th the female definitely flew off the nest which, as anticipated, again contained 3 eggs including the new laid fourth egg which was very handsome. A fifth egg in the nest on 30 May was uniformly blue-white without a single mark. On account of anti-bandit operations no further visits were possible.

By this record breeding is established but racial identity remains unsolved. I could detect no difference other than the male's rich colour between them and normal visiting sparrow-hawks, some males of which have pink underparts, and think it possible that this pair might have been *A. v. gularis* which stayed to breed. Eventually this may be confirmed or contradicted if and when breeding birds are subsequently taken and proved to be some other race. In the meantime these facts are cited in support of the *gularis* concept. Bay-headed Bee-eater, Brown-breasted Bee-eater, Black-capped Kingfisher, Pied Imperial Pigeon, Little Grebe, Bronze-winged Jaçana, Philippine Banded Crake, Short-toed Eagle, Tiger Bittern, Yellow Bittern, Schrenck's Bittern, Night Heron, Little Egret, Cattle Egret, Pratincole—all classed as migrants and winter visitors—remain to breed, so there would appear to be no valid reason why any species at any time should not extend the conventionally known limits of its breeding range.

Blyth's Hawk-Eagle : **Spizaëtus nipalensis alboniger** (Blyth)

Early in January 1950 when vacationing on Penang Hill, I became aware of the presence of a pair of birds, and after seeing and hearing them continuously every day for three weeks they became as familiar as Fairy Bluebirds. Smaller than Changeable Hawk-Eagles and entirely different in colour, they are adequately described as being all black above and streaked and barred black and white below. The bill is black and the feet are yellow. On this occasion I was fortunately placed for observation. The house I occupied, situated at 2200 feet (*c.* 670 m.) elevation, overlooked the densely forested valley which was their favoured habitat; and it was in this valley they built their nest. In doing so the birds passed just beyond and below the house level when bringing material, and I could watch whilst sitting in the garden or from any southward-facing window. Sticks were occasionally carried crosswise in the bill, but more frequently in one foot either crosswise, lengthwise, or hanging below the foot. Both legs were always down but only one foot held the stick. For a week this was the daily routine. Then all activity ceased after 10 January, so they must have started early December. In the meantime I had located the selected tree, which was actually higher up the valley than the house and was approximately 2350 feet (*c.* 720 m.) above sea-level. Knowing from experience the leisurely habits of the big Raptores I left it severely alone and devoted my time to other species. Every day I saw the eagles circling and winging their courses just above the treetops and calling repeatedly in flight. This call is a resounding tri-syllable *kee-lu-kuk*, which echoes round the hills and totally unlike the Changeable Hawk-Eagle's clear, double *blee-kwik*. Time passed and it was 28 January when I eventually returned to the eagles' tree with my climber Awang, the best of many I ever had. He was more than half way to the nest before the eagle went off in a hurry, the vibrations of his ascent having registered rather late, probably because she was asleep. The nest proved to be 75 feet (*c.* 23 m.) up, placed in a stout treble fork of the tree bole and at least 20 feet (*c.* 6 m.) below the canopy. The exterior diameter measured 2 feet 6 inches (*c.* 75 cm.), the interior 1 foot 6 inches (*c.* 45 cm.), and the stick pile 1 foot 3 inches (*c.* 38 cm.) thick. It contained a single egg lying on desiccated green leaves with four sprays of green leaves round the inner perimeter. The unglossed grey-white shell was strewn with flecks of claret and had sub-surface grey patches at the smaller end, which may or may not have been leaf stains. It measured 59×48 mm. Subsequent history shows that a pair, probably the same, bred in the same locality in 1951. In 1956 a pair bred in another forested valley 3 miles (*c.* 5 km.) to the south at an elevation of not more than 1000 feet (*c.* 300 m.), and in 1959 a pair bred in Batu Ferringhi Forest Catchment Area at not more than 600 feet (*c.* 180 m.) elevation. The relics of this eyrie still linger.

Black Eagle : **Ictinaëtus malayensis** (Temminck)

The Black Eagle is unmistakable. Including the bill it is completely black with numerous faint grey bars across both sides of the tail; and bright yellow legs, and feet.[1] It is larger than the Hawk-Eagle with a longer tail; and on the wing is truly a magnificent bird. Strangely enough, although resident, its breeding in Malaya has not been reported, probably because its chief habitat, mountain forest, is difficult of access and more than difficult to negotiate. Thereafter guess work and frustration begin as all who have entered mountain forest must know. Once in, there is no way of seeing out, and even if an eagle or any bird passes above the canopy it cannot be seen or cast a shadow which in the open normally betrays a large bird passing overhead. If the forest is scanned from some vantage point above it there is no way of seeing in, and eagles' nests are always below the canopy. My first inclination was to use the vantage point method, try to locate a bird on the wing and watch it down to its final tree-fall. Then it occurred to me that, if I could locate a bird on the wing whilst I myself was outside the forest altogether and looking up some hill face, I might do better; so for 7 consecutive days from a different place each day, I gazed over green treetops into birdless blue skies. This was April and I did not know whether Black Eagles nested in April or any other month earlier or later, but on the 8th day, just before 10 a.m., I picked up two birds in the field of my glasses, one slightly larger than the other and evidently a pair. They were swinging round in opposing circles, drifting gradually towards the hill forest which faced south-east. Using ×15 binoculars, I followed the aerial evolutions of the female and gave a pair of ×10 to my climber to follow the male. At 10.20 a.m. she stopped gliding, dropped her feet and, on slightly retracted wings, sped towards and into the trees at an elevation close to 300 feet (*c.* 90 m.). She did not alight on a tree but went straight through a gap in the forest 'roof'. In the meantime the male had simply drifted off southward. After memorising everything possible that would help to guide us, we sat in deep shade by a stream and shared a big pomelo—the best thirst deterrent in forest work. Starting about noon and surmounting the tortuous hazards of the ascent we finally, at 3.30 p.m., came upon an eyrie in a big tree. At the striking of the trunk with a heavy bough off went the Black Eagle uttering as she left one loud whistling squeal. The eyrie was a massive structure, the basal sticks weathered grey denoting considerable age, whilst the upper mass was fresher and some green-leafed sprays were visible at the rim. It was placed in a great central junction of three boughs at 90 feet (*c.* 28 m.) from the ground—the canopy another 30 feet (*c.* 10 m.) above it—with not a single branch on the entire 90 feet (*c.* 28 m.) of the trunk. Seeing no more of the eagle and being too late in the day to make such a climb, we returned to camp for the night. The date was 25 April 1958. Starting at dawn next morning we were approaching the tree by 8 a.m. There was an eagle on a bough above the nest, and within moments another rose out of the nest and stood on the rim. This was the male. There was no alarm since our presence was still unsuspected. At 8.20 a.m. the female came down to the nest and settled. Not until then did the male glide out of the forest.

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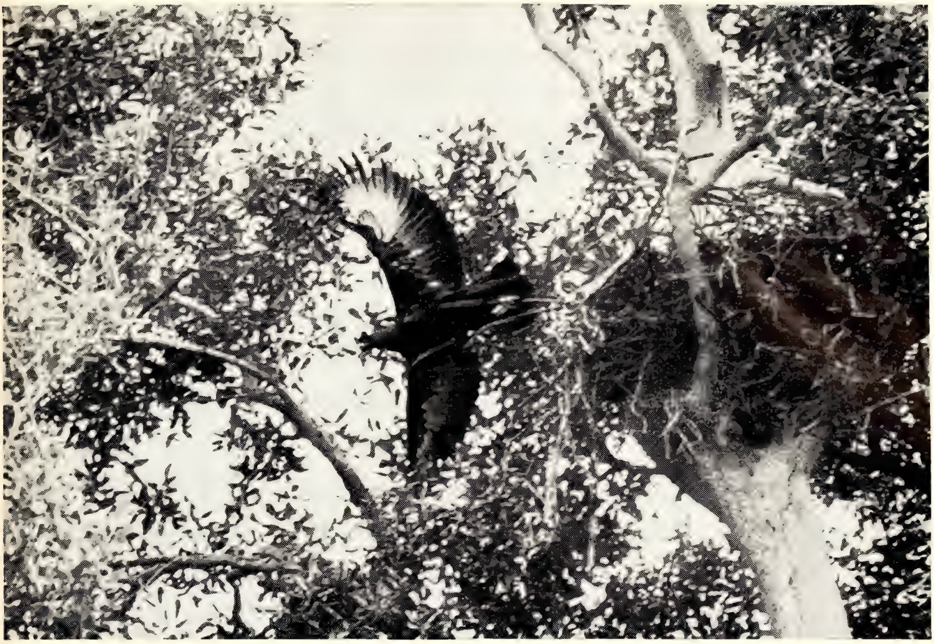
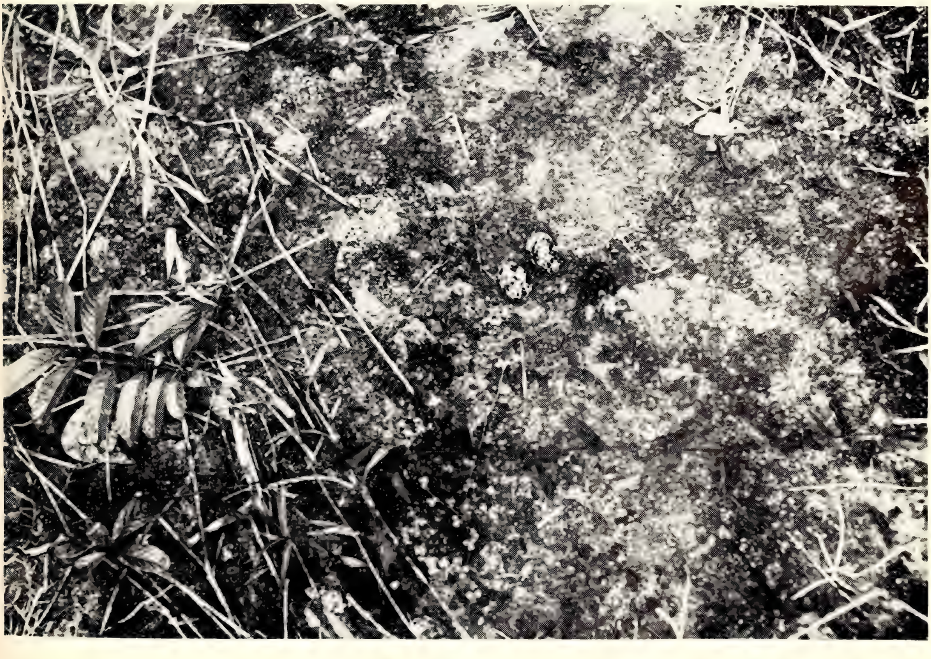
[1] The yellow cere, and gape are very noticeable in the Indian bird.—EDS.

Malays have two methods of tackling big trees and Razali, my climber on this occasion, was an adept at both. The first method is slow and laborious; it consists of lashing saplings to the bole of the tree all the way up, with short cross pieces for resting at 10 foot (*c.* 3 m.) intervals. This 'pipe', of course, has to be fixed in sections one at a time and is a most arduous undertaking since the higher it goes the longer each descent for and ascent with the next section becomes. This is always the method employed if the bark is smooth or wet after rain. If the bark is rough and dry (in the present case it was), then two loops of half-inch (*c.* 12 mm.) rope are sufficient, one stretched between his feet, the other passed round the trunk and stretched between his hands, thus completely spanning the circumference which his arms alone could not do; he then 'stands' by the pressure of the taut foot-rope, flicks the hand-rope upwards, leans back on it, brings up his feet and so, by a continuous series of caterpillar loops, goes up in no time at all.

The eyrie interior was clean, fresh, shallow, and about 2 feet (*c.* 60 cm.) wide, and contained two eggs lying on a bed of flattened green leaves. Exterior diameter was 3½ feet, so that the rim all round was a foot and a half wide. The height of the structure was 2 feet 6 inches (*c.* 75 cm.). Razali had taken up with him 200 feet (*c.* 60 m.) of half-inch (*c.* 12 mm.) rope for the dual purpose of letting

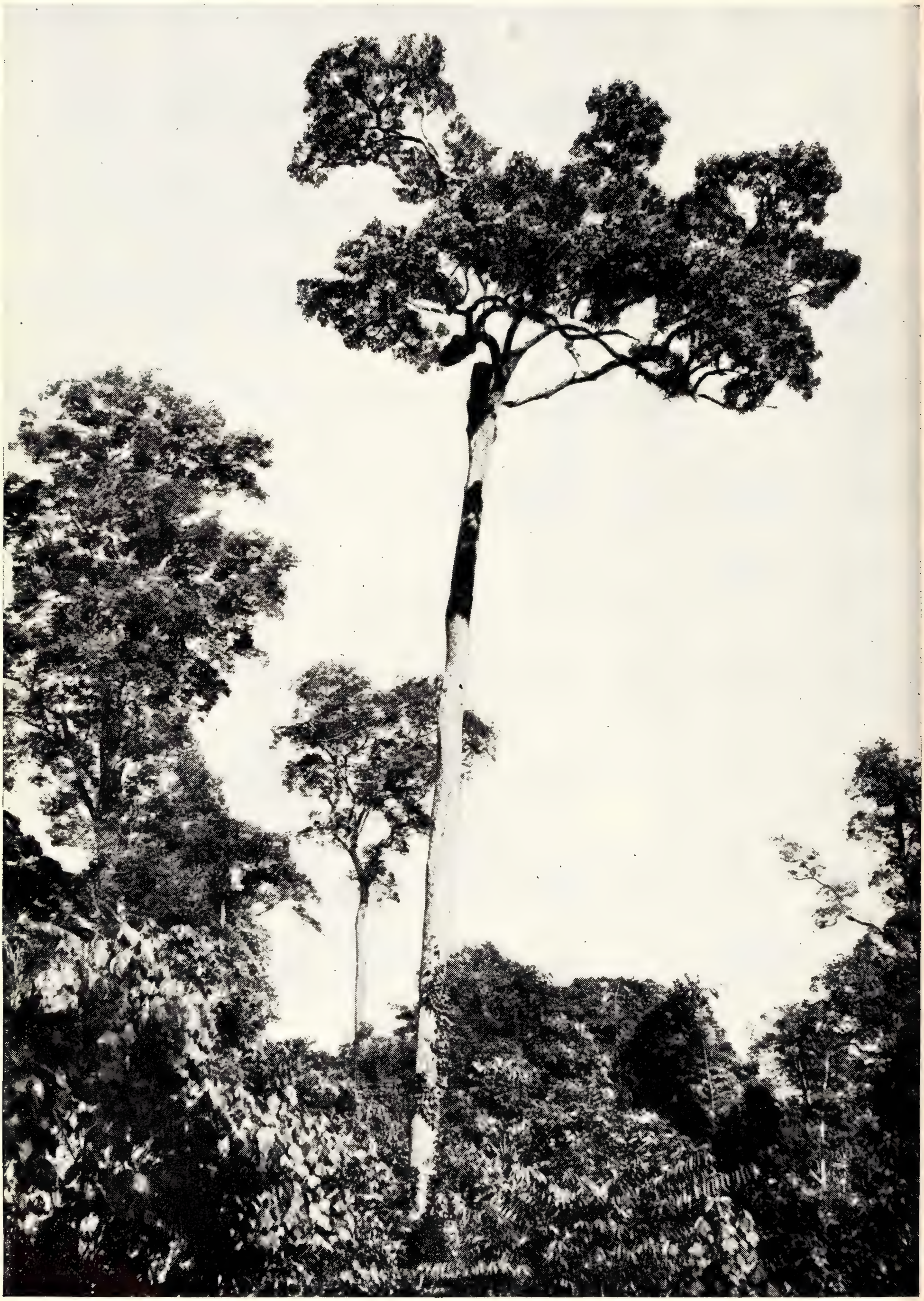


Black Eagle. Male leaving eyrie



Pratincole's nest, containing two eggs and showing remarkable harmony with surroundings

Photos : J. Cairns



Nest and nesting tree of the Lesser Fishing Eagle

Photo : J. Cairns

down the contents for inspection and measurement, and making his descent easily and quickly simply by leaning outwards facing the tree and 'walking' down while holding the rope double slung from above. One egg was white, handsomely splashed with rich brown and clouded with ochreous pink and soft grey, and measured *c.* 69×53 mm. The second egg was also white clouded with pink and grey, but had no dark splashes. Slightly larger, it measured *c.* 69.5×53 mm. From the appearance and feel of the shells I estimated that incubation had begun about a week before. Whilst Razali was at the nest around 10 a.m. the eagles were not heard or seen, but after his descent one bird returned and settled, and although we kept watch till mid-afternoon, we did not see it leave. Inaccessibility and security are surely synonymous for breeding success, yet Black Eagles still remain rare birds and never seem to increase. The nest described above is located in the Jedok Forest Reserve, Kelantan.

Lesser Fishing Eagle : **Icthyophaga nana nana** (Blyth)

Over a period of 40 years I have seen five nests of the Lesser Fishing Eagle, four in Kedah and one in Perak. This species is considerably smaller than the Black Eagle and, of course, strikingly different in appearance. The entire head, neck, breast, flanks, and underwings are unblemished ash-grey. The abdomen, thighs, and underside of the tail are pure white. The back, wings, rump, and upper side of the tail are brown. The grey of the breast and the white of the abdomen do not merge. They meet and remain sharply contrasted across the body, and this forms the most striking feature of the plumage. The bill is blue-grey, and the legs and feet are pale grey. Although this bird is not particularly scarce, yet it is rarely encountered since it avoids open country and frequents inland forest and river reaches with heavily forested banks. Finding a nest is a matter of luck; a bird may be seen flying into or out of a tree and there it is. Nest building takes a very long time, as the bird seems to be exceedingly fussy over sticks, many of which are either deliberately discarded or accidentally dropped, judging by the numbers that strew the ground at the base of the tree. I never have seen sticks at the base of a nesting tree used by any other species of eagle. My experience is that a bird which starts building in December lays its eggs in February. The large structure of sticks is wide and flat and not piled high, with a spacious shallow interior lined with green leaves mixed with leaf debris. The eggs, two or three in number, laid at intervals of 4 days, are smooth in texture and uniformly grey-white without marks. The average measurements of twelve are

57×45 mm. One constant factor applies to all 5 nests. They were placed very high in big trees—three isolated and two not—at the edge of dense forest, and in every case far out from the trunk near the end of a strong horizontal bough. The call in flight is a double-syllabled nasal yelp which echoes among the trees.

Short-Toed Eagle : **Circaëtus gallicus** (Gmelin)

One mid-November day in 1954 I was working through heavy swamp immediately east of the mangrove belt along Penang's west coast and, on pausing for a quick survey ahead, I picked up through my glasses and a long way off a large bird perched on a low stump. It was obviously a raptore but too white and also perched too low to be in character with more familiar species. Taking advantage of available cover I pushed on and closed the gap to about 50 yards (*c.* 45 m.). The bird was still on the stump intently gazing down into the swamp herbage. Presently it jumped off without using its wings into deep growth on its right, remained out of sight for perhaps ten seconds, then flapped back to the perch with a snake about three feet long, wriggling in its talons. This was a fortunate occurrence from the observational point of view, because the bird was now forced to adopt many attitudes with wings outspread for balance while manoeuvring with the snake. I was therefore able to note every aspect of plumage and identify it as a splendid adult Short-toed Eagle, *Circaëtus gallicus* subsp. The snake was eventually swallowed whole head first. Seen in flight from below this eagle is the whitest of all eagles, and the present specimen was almost uniformly white with dark wing tips and only slight duskiness across the breast. The white undertail showed three cross-bars, the bill was blue-grey, the naked tarsi pale grey, and all upper parts including tail showed a marbled effect of honey-brown with flecks of grey. The head had a slightly flat-faced appearance reminiscent of an owl's. Leaving it undisturbed I veered away on a wide detour but returned in the afternoon when I saw it again, about 20 feet (*c.* 6 m.) up, quartering the swamp like a harrier and hovering briefly at intervals. Back in the vicinity on 4 December I found to my surprise a pair of birds. I watched them soaring, searching, feeding, preening, resting; and incredibly also building an eyrie already of considerable bulk. From then on they became my sole obsession, and I returned three times every week to record progress. The chosen tree was a fringe tree of the mangrove forest overlooking the swamp, stout but not very tall, and the eyrie was placed against the trunk at a double fork and only 65 feet (*c.* 20 m.) from the ground. In the course of time it became a huge structure of sticks and could be seen against the sky from a long distance. Yet it survived all hazards and was never disturbed. Although the birds seemed never to do very much building the aggregate of material was astonishing. By 8 January 1955, all building appeared to have ceased and not a bird was seen all day. In order to get a clue to possible events I had my climber examine the nest. It was empty. On the 15th again no birds and no egg. On the 19th still no birds and no egg and then, on the 22nd, as we approached the tree the tail of the brooding eagle was visible. After one sharp tap on the trunk she rose out of her eyrie and stood on the rim a few moments before launching herself over the forest. The single large egg was oval in shape, unglossed, bluish white with very few specks of russet here and there but scarcely noticeable—and measured *c.* 73×57 mm. The egg was lying on shiny dry leaves surrounded by fresh green ones and must have been laid on the 20th, 21st, or 22nd, practically two whole months after nest building began. Five tufts of white down were noted. The bird returned and left twice during the next hour but did not settle.

The strange absences and long delays between completion of nest and egg-laying are also typical of Changeable Hawk-Eagles, *S. c. limnaeetus,* and Serpent Eagles, *S. c. bassus.* Incubation lasted 28 days and the eaglet remained in and at the eyrie for 3 months. The Short-toed Eagles also bred in 1956 and 1957 in the same area but used different trees. In 1958 they moved to the foothills east of the swamp.

This eagle is unique in that it moves about on the ground and perches near the ground looking and waiting for food, and this is the only successful hunting method I witnessed. It also soars and glides and cavorts grandly and easily, and rockets earthward at great speed with half closed wings. I believe this to be solely a spectacular way of descending and not a prelude to pursuit or capture of prey. The adult call is a soft but far-carrying *plu-ee.*

Family HELIORNITHIDAE

Masked Finfoot : **Heliopais personata** (G. R. Gray)

The Finfoot is a resident bird, yet its nest has never been reported within Malayan territory. This is surprising because, although it is a shy bird, it is not a small bird [being some 20 inches (*c.* 50 cm.) long] but it is definitely rare. In my experience it is not so widely distributed as it is said to be. On the contrary I consider its range extremely limited. Having made extensive explorations through every State in Malaya I never have seen or heard a finfoot anywhere except in Perlis and Kedah, and it was in the latter State I eventually found the bird breeding. There is no other waterbird like it. The sexes are similar with the exception of one distinguishing feature which is easily seen and remembered. The male has a black throat and foreneck with a thin white border all round the black; the female has a white throat and foreneck with a black border all round the white, and the black in turn is narrowly edged with white. Otherwise, both have black crowns, grey necks, oily-greeny-brown backs, wings, and tails, white underparts, yellow bills, and light green feet. The legs are placed far back, and the bird has a sleek appearance when swimming low in the water like a grebe. When taking off, which is seldom, it runs along the surface with pattering feet until air-borne. Flight is strong and straight. What astonished me most was its running ability on land. It is an expert diver when fishing, but when alarmed submerges by sinking without a ripple. The call of the male is a phrase of falsetto bubbling notes, and that of the female a lower pitched gurgling akin in quality to the frenzied nuptials of White-breasted Waterhens. To me the breeding season is synonymous with rains. Although I have examined sixteen nests: one in July, three in September, and twelve in October, yet before the discovery of the first of these in October 1941 I had been twenty years in Malaya. During the twenty years since, knowing where to look and when to look, the fifteen others were, of course, confined to the years 1946 to 1961, giving a yearly average of one, but this component includes four nests in one season. The Finfoot breeds in flat scrub jungle flooded by overflowing small streams. If there is no flood water it does not breed. I have proved this to my own satisfaction by visiting the habitat monthly through a calendar year. Thus, the solitary July discovery was made because there was flood water, the depth of which is usually from 6 to 9 inches (*c.* 15 to 23 cm.). Nesting sites vary in height above water, 3 to 6 feet (*c.* 1 to 2 m.) being normal, and lower or higher abnormal. One does not naturally associate waterbirds with sticks, yet all the Finfoot nests I have seen were made of fine sticks and lined with dried bamboo leaves. Each structure was about one foot thick and closely packed into a neat tight mass. This neatness has always impressed me and is diagnostic. The most favoured sites were recesses in the 'walls' of big upturned tree roots, on vertical tree stumps, and near the ends of horizontal tree boughs thrusting into ground scrub. Both sexes incubate and in doing so sleep swan-like with necks over their backs. When disturbed they simply plop into the water and melt away into the forest mazes. Full clutches of eggs range from five to eight in number, seven being most frequent. They are roundish ovals with medium glossy textures. Typical eggs are creamy-white bearing rich chestnut splashes and violet areas which, however, become pale grey with the passage of time. Another type is moorhen-grey with similar colours but the grey reduces the colour intensity. Average dimensions are *c.* 49×41 mm.

Family GLAREOLIDAE

Pratincole : **Glareola maldivarum** J. R. Forster

In my experience pratincoles with red underwings are irregular November visitors to north Malaya: numerous, scarce, or absent altogether for reasons unknown. I have no earlier record of arrival; and my records for northward passages are all in February. Considering that these records cover a period of 40 years this dual consistency is remarkable. Nor have I ever discovered where the birds go in the intervening months. On the other hand, E. H. Bromley once told me that when he resided in Alor Star, pratincoles were present from March to July. This undoubtedly spans the breeding season but no nest or nestling was ever found or seen. It is therefore gratifying to be able to report now that pratincoles do breed in Malaya.

In 1958 I spent three months—April, May, June—in Kelantan and Trengannu and when I made the discovery no thought of pratincoles had even remotely entered my mind. I was quartering some old ploughed and tussocky land looking for the nests of 3 pairs of Red-wattled Lapwings, *L. i. atronuchalis,* whose habitat I had previously noted, and in doing so walked into the pratincole colony. The date was 20 June. In the ensuing three hours I located 15 pratincole nests over an area of approximately six acres and the lapwing nests as well. One of these containing 4 eggs was 10 feet (*c.* 3 m.) from a pratincole nest with 2. The other lapwings' nests contained 4 and 3 eggs respectively and were outside the precincts of the colony. Of the 15 pratincole nests three contained 3 and twelve contained 2 eggs in various stages of incubation from fresh to near-hatching; ground colours varied—pale straw, grey, or green—and carried spots and fine broken scrawls of sepia and black bloomed with violet. All nests were slight depressions: ten in dry broken-down earth, four on dried cow-pats, and one on solidified mud. Not a single nest had any shelter, and under the boiling sun the birds brooded their eggs with wide open bills and throbbing throats. Average measurements for the 33 eggs were 32×23 mm. The pratincole's flight is easy, leisurely, and buoyant. From the ground it starts off low and gains height by a long gentle upward trend. The double call note *kee-tik* has a light timbre and tern-like quality. Notes of protest sounded like *tee-tirek, tee-tirek*. When the bird is incubating or standing the long crossed wing-tips can be mistaken for the deeply forked tail. In flight the prominent feature is the white rump.

A Malay shepherd on the spot with whom I spoke knew of no Malay name for the bird, but was so familiar with it as to show no abnormal interest, merely adding that he had seen eggs in previous years in different places and that the birds would disappear in August. These simple facts were given in reply to my relative questions and at least confirm the new status of this dainty bird probably the Eastern Pratincole, *Glareola maldivarum*, as a breeding summer visitor. The breeding ground is in Trengannu, practically on the same latitude as Penang, which for comparison is at least 60 miles (*c.* 97 km.) further south than Alor Star.

Family TIMALIIDAE

Rail-Babbler : **Eupetes macrocerus macrocerus** Temminck

On 29 May 1958 I entered the Lebir Forest Reserve in the vicinity of Jeram Chalil, after travelling for several days some twenty miles up the Sungei Lebir from Manek Urai. This Forest Reserve throughout its whole length of 30 miles (*c.* 48 km.) lies between the Sungei Lebir on the west and the Kelantan-Trengannu State Boundary on the east, while its southern end, about 7 miles (*c.* 11 km.) wide, meets the north-eastern extremity of King George V National Park under the great north massif of Gunong Tahan. In this forest at an elevation of about 500 feet (*c.* 150 m.) above the river I stumbled across what is probably the first Rail-Babbler's nest ever found in Malaya. As usual I was not looking for or expecting such a rarity, since I have yet to meet an ornithologist who has even seen the Malayan bird, and until I found this nest I was in the same category. My chief objectives—hornbills, pheasants, peafowl—were forgotten and abandoned and throughout the day I made observations and notes on the nest which are now rendered verbatim. 'A ragged assembly of thin sticks, tangled tendrils, and black leaf-mould forms the basic structure; on this foundation rests the cup-shaped open nest composed of fibrous roots, lichens, and some moss in places; densely and neatly woven. The diameter of the interior is 4 inches (*c.* 10 cm.), its central depth 1½ inches (*c.* 4 cm.), and the entire lining composed of skeleton leaves. On this gauze-like bed lie two beautiful pink eggs, the larger ends circled by zones of russet. They are longish slightly pointed ovals, have a fine texture and slight gloss, are quite fresh, and measure *c.* 30×22 mm. The nest is placed on a flat-topped boulder well-covered with vegetation and only 2 feet (*c.* 60 cm.) high, and even when known is scarcely visible at very short range. In fact the only reason I did see it is because the bird jumped off close to my knee. Both birds are alike and, although exquisitely plumaged, appear soberly coloured in the sombre forest light. They have no fear of me. They do not fly; simply move about on or near the ground and jump up to or down from the nest, turn over leaves, pass food to each other, and neither has uttered a single note in four hours.'

Family PARIDAE

Sultan Tit : **Melanochlora sultanea flavocristata** (Lafresnaye)

In the hill forest of Penang there is no other small bird like the Sultan Tit. For a tit, its plumage is revolutionary. All underparts of the male's body below the chest and the striking head crest are bright yellow, while the rest of the bird is entirely black. The female is not quite so yellow and not quite so black. Two other non-tit-like features are the large size [8 inches (*c.* 20 cm.)] and the graduated tail. However, its voice, nest, eggs, and nesting sites are similar to those of the true tit family, Paridae. Small parties move about in forest glades above the 2200 foot (*c.* 670 m.) contour and attract attention by their continuous churring chuckling as they search for food among green foliage; although decaying timber, standing or fallen, always receives special attention. When so encountered at ground level watching them is indeed a pleasure—absorbed in their searching and showing no concern or apprehension of possible danger. Their actions are deliberate, not jerky, and convey an impression of never being in a hurry. Spiders, caterpillars, grubs are placed under the feet and the contents only of their bodies eaten piecemeal. Butterflies are also caught and devoured in the same way after nipping off and dropping the wings. One call phrase is a pleasant *zip-tree-tree*, another is *zup-zee zup-zee zup-zee* repeated over and over; another, a slow mournful plaint, *pay-pay-pay*, when disturbed from the nest: besides the customary puffed-throated churring at any time. As in the case of the Malayan Great Tit, *P. m. ambiguus*, whose life-history and nesting habits I have fully described in the *Journal of the Bombay Natural History Society*, 1956, (**53** : 367-73), the female collects all materials and builds the nest wth the male accompanying her to and fro on every trip. Breeding activity is greatest during the period February to May, its peak March-April with an occasional late nest in June. The only way of locating a nest comes through a fortunate chance encounter with the female collecting materials, which she usually does near or on the ground, and watching her to the site, which may be difficult or easy according to the forest density. Holes in living trees are favourites, ranging in height from 8 to 50 feet (*c*. 3 to 16 m.) though most nests are around the 30 foot (*c*. 10 m.) mark. I have always wondered and wished to know why the chosen hole is chosen, with so many others in the vicinity, but I suppose I never shall. The nest is a thick pad of green mosses, soft lichens, and spider-silk, lined with cream-coloured flower floss mixed with thread-like fibres and shaped to the mould of the cavity. Four to six eggs are laid, five predominating. They are pure white, splashed and spotted with clear light red, and although similar in colour to those of the Great Tit and the Velvetfronted Nuthatch are, as they should be, distinctly larger averaging *c*. 18×14 mm. During incubation, there is no sound or clue to any nest location, but when eggs hatch on the 14th day both parents enter upon a period of prodigious feeding activity. They enter and leave the nest without reference to anything or anybody close by. At this time I am always surprised by the number of females I did not see when they were building one month earlier. Fledglings come out of the nest around the 15th or 16th day after hatching and wait to be fed on convenient boughs. For a few more days both parents still feed them, but when they are able to fly and follow through the trees, the male alone caters for the family. This peculiar habit is also true of the Great Tit.

Family SITTIDAE

Velvetfronted Nuthatch : **Sitta frontalis saturatior** Hartert

This beautiful little bird is widely dispersed through the forest on Penang Hills, also above the 2200 foot (*c*. 670 m.) contour. Just 5 inches (*c*. 13 cm.) long, its violet-blue upper parts, lilac-peach under-parts, combined with its bright vermilion bill, are arresting features as the bird runs up and down tree trunks with jerky movements. It descends head first, not tail first like Woodpeckers. In the brilliant months of January and February it is more frequently seen than in any other month, probably because of its fondness for 'wintering' trees. In addition, these are the nuptial months of pairing, nest building, and flying together. Small parties are also fond of travelling together at this time of the year, and exhibit an astonishing habit of visiting the same group of trees every morning about the same time; constantly twittering, whether feeding or flying. This would appear to indicate a scheduled daily circuit of territory. Appearances and departures are instantaneous and for this reason disconcerting. Never a sign of site prospecting! Never a clue to nest building! My constant surmise for many years was simply how, when, where do they build, for in any dense rainforest there is no way of following small fast birds and everything is relatively accidental. When eventually I had the solution its simplicity was slightly fantastic and will no doubt appear so now in retelling. Over and over again I had noted that favoured feeding trees were in glades of thinner forest or at forest fringes which received strong sunlight. One day I decided to examine one closely (something I had not done before) after the visiting party had gone. I struck the trunk sharply with a stick and from a crevice in the trunk only 10 feet (*c.* 3 m.) up there emerged a female nuthatch. I soon reached the crevice which was 6 inches (*c.* 15 cm.) tall × 2 inches (*c.* 5 cm.) wide, and using a torch I could see six eggs in a fur and feather lined green moss nest about 5 inches (*c.* 13 cm.) down in the cavity. By the pink appearance of the white shells I could tell they were fresh. Markings (freckles and small splashes) were red. There was no plastering at the entrance. The date was 4 February 1950. So, in this case at least, the feeding tree was the nesting tree of one pair, and the morning parties were visitors. This discovery sent me off on a speculative visit to two more party feeding trees which I knew, incidentally far apart, and a pair of nuthatches had a nest in each. This phenomenon invariably happens in bird-nesting. Years may pass before finding a first nest; yet as soon as this is found a second and third turns up, sometimes immediately or very soon afterwards. Because of this experience I am not implying that these are the only sites used. There must be others but I have yet to find them. Five or six eggs are normal clutches. They measure *c.* 17 × 13 mm., and the exact nesting season I place from the last week of January through February to the first week of March. The richly coloured birds on Penang Hills are undoubtedly *S. f. saturatior*. Only once have I ever heard and seen this species away from the hills; and that was a single bird in one of the tall Angsanna trees bordering Light Street near the General Post Office on 11 March 1949. Out of these notes emerges one unresolved surmise as to what birds are free to make up the parties which continue their morning visits throughout the breeding season.

Entomological Survey of Himalaya

Part XXVI. A Contribution to our Knowledge of the Geography of the High Altitude Insects of the Nival Zones from the North-West Himalaya

PART 6

BY

M. S. MANI, D.SC., F.L.S., AND SANTOKH SINGH, Ph.D., F.R.E.S.

(*With one text-figure*)

[*Continued from Vol.* **59** (3) : 861]

VII. CONCLUDING REMARKS

The zoogeographical problems of the nival insects from the NW. Himalaya centre largely around the high endemism of a cold-adapted, ecologically highly specialized, Tertiary-mountain fauna. Attention has already been drawn to the very high proportion of the Tertiary-mountain element and it has also been shown that at least 60% of the mountain species, found at present above the timber-line, have had their origin within the region of the NW. Himalaya. Large-scale migrations of the present species-complex of the nival zones from outside is thus at once ruled out.

From his extensive studies on the Palaearctic bumble-bees, Skorikow (142) concluded that the region of the Tertiary mountains constitutes an independent place of origin of many fauna within the Palaearctic Realm. The NW. Himalaya is one such important region of recent faunal development and differentiation. The possibility of the origin of many races, subspecies, species, and even genera in such a recently disturbed area was not overlooked by Eidmann (34) in his general remarks on the ants from the Nanga Parbat area. It is also readily apparent that the endemism of the Tertiary-mountain autochthone fauna of the NW. Himalaya is naturally closely bound up with the rise of this mountain system.

At least in so far as the NW. Himalaya is concerned, there seems to be little doubt that the present nival insect fauna above the timber line certainly did not ascend to these high elevations, either from the surrounding lowlands or even from comparatively lower elevations. On the other hand, there is every indication that the territory, which the ancestors of the present nival insect fauna occupied, was uplifted by the Tertiary orogenic movements to the high elevations where the endemites and others are now found. The endemites thus arose *pari passu* with this uplift of the Himalaya and are therefore in every sense products of the growth of the mountain system itself.

The origin of endemism. As is well known, the Himalaya is a series of more or less parallel or nearly converging ranges of high mountains, intersected by longitudinal valleys (18, 81, 82, 153). The NW. Himalaya is connected with the other Tertiary and older mountain ranges of Asia in the so-called Pamir Knot (Fig. 35). This is really an enormous area of the earth's surface, which has undergone considerable recent folding, crumpling, thrusting, and other violent crustal movements during the Tertiary Epoch. The equator-ward movements of the Angaran land mass caused the uplift of the Tethyan sediments and the obliteration of the Tethyan sea. The Gondwana land mass on the south also produced an under-thrust towards the central Asiatic mass and thus contributed to the uplift of the Himalaya. These orogenic movements are believed to have occurred in four major phases respectively in the Upper Eocene, the Middle Miocene, Pliocene, and Pleistocene. The thrusting movements produced a series of folds. The curving of the NW. Himalaya away from the rest of the Himalaya east of the River Sutlej is believed to be due to the resistance by the Gondwana mass to the equator-ward movements from the north.

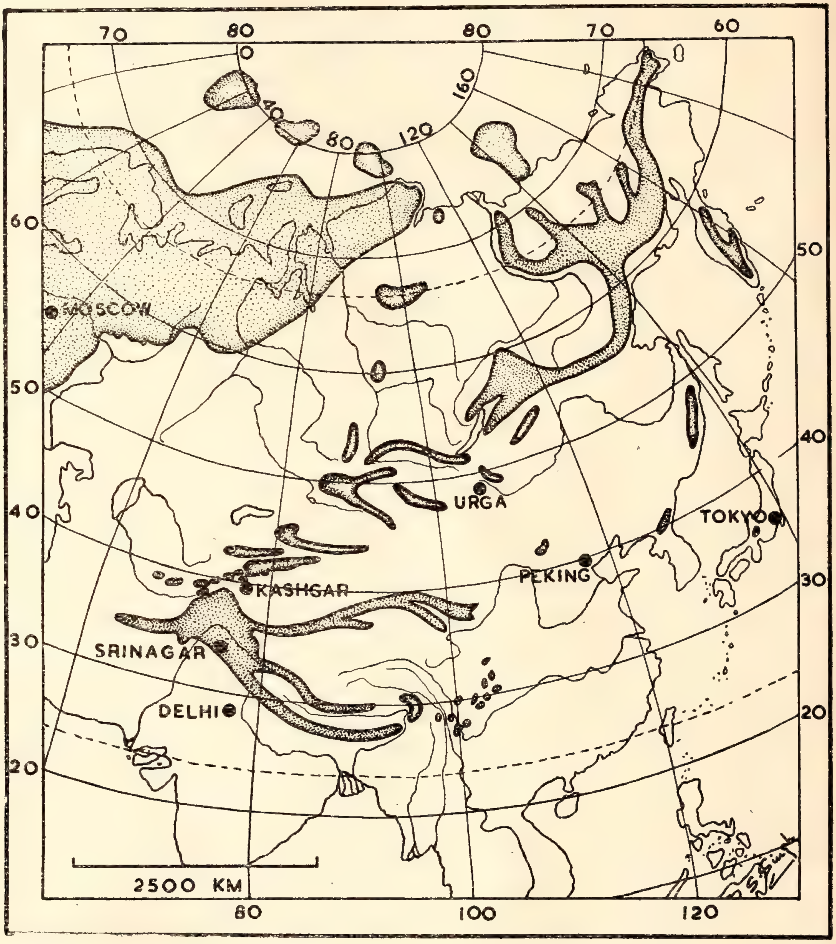
The obliteration of the Tethyan sea and the uplift of the Tethyan sediments opened up the possibilities of the southward extension of the Angaran lowland and mountain (Asiatic) faunal elements. While the central granite mass of the Great Himalaya was breaking up through the Tethyan sediments, and other crustal movements succeeded one another, the insect fauna, which had already peopled the region, was also simultaneously uplifted to elevations, often even higher than those which species generally inhabit at the present time. The Angaran ancestral stock of the older Asiatic mountain-autochthones spread by way of the Pamir to the NW. Himalaya. The occurrence of *Conophyma* and *Gomphomastax* on the Turkestan mountains, Pamir, and NW. Himalaya is explained, for example, by Uvarov (149) on the basis of the tropical and sub-tropical Angaran faunal elements of the region being elevated at the same time as the uplift of the mountains and simultaneous evolution to the cold-adapted types. With the uplift of the Tertiary mountain system, the Tertiary tropical and sub-tropical fauna were in a sense transported to alpine and arctic climates. That the present nival insect fauna of the NW. Himalaya are really central Asiatic derivatives, and have had very little or no substantial contribution from the southern Gondwana stock is indicated by the absence of the latter and the presence of numerous typical Angaran and high northern genera like *Nemoura, Nysius, Chlamydatus, Bembidion, Cymindis, Nebria, Trechus, Atheta, Parnassius, Colias,* etc. The present distribution of *Bembidion fuscicrus* Motsch. (Fig. 16), *Catapionus* and *Scepticus* (Fig. 20), *Subterraneobombus melanurus* (Lepel) (Fig. 23), the fourteen subspecies of *Karnasa hübneri* Feld. (Fig. 30), Deuterophlebiidae (Fig. 31), and *Aëdes* (*Ochlerotatus*) *pullatus* Coq., and *Ephydra glauca* Meig. (Fig. 32) is also additional evidence of the northern origin. The higher endemism and other peculiarities of the Indus province, to which we have already referred, are also best explained by the northern stock. The crest line of the Great Himalaya seems to have been an effective barrier to the Gondwana elements. Furthermore, it was not until the uplift of the NW. Himalaya had progressed sufficiently high to start deposition of sediments on the south that any direct route became available for the Gondwana fauna to the Himalaya (27, 32). The only endemite of undoubted southern source is *Phaeropsopus stenoderus* Chaud., which, as we have already indicated, is confined to the timber line altitudes on the outer Himalayan ranges and is never found north of the crest line of the Great Pir Panjal Range. This species is obviously neo-endemite (Post-Pleistocene origin).

Although the southward extension of the Angaran lowland insect fauna must have followed soon after the obliteration of the Tethyan sea, the transformation of the tropical and sub-tropical lowland forms to the cold-adapted mountain-autochthone elements seems to have come about probably only during the late Miocene, when the Pamir-Karakorum-NW. Himalaya region had reached sufficient elevation. The ecologic specialization of these cold-adapted Tertiary-mountain fauna seems to have reached its climax during the Pliocene uplift of the Himalaya and thus also culminated in the origin of the endemism that characterizes the nival insect fauna at present. The endemites are thus largely of Pliocene origin. The entire nival insect fauna of the region is indeed of Tertiary development. None of the genera, and often even many of the families represented in the present nival fauna, are known to have existed before late Eocene. The genera *Amara, Trechus, Nebria,* and *Bembidion* are known as fossils only from the late Eocene and others like *Aleochara* and the family Bombidae are known from the Miocene (52, 53). It is, therefore, not possible to assign an age older than late Pliocene for the greatest majority of the endemic species. It is also only the phylogenetically young and thus plastic groups that could be expected to evolve the high altitude specializations for life in a newly elevated region. Thus, most endemic genera like *Dicranophyma, Dolmacoris, Tibetocoris, Chaetobroscus, Ascelosodis, Bioramix,* and *Stenophylina* would appear to be of late Pliocene or also of Pleistocene development. Petersen (118), who studied the speciation in the cold-adapted Holarctic fauna, concluded that at least in the case of insects it was not before the Pliocene that cold specialization arose. It is also apparently during the Pliocene that the central Asian, cold-adapted mountain-autochthone species spread north-east to the Nearctic Realm and south-west and south to the NW. Himalaya, using the chain of mountains as migration route. The Mediterranean elements also appear to have more or less penetrated the NW. Himalaya about the same time. Though the bulk of the endemites are of Pliocene development, many would also appear to have become differentiated during the Pleistocene. The local subspecies of Coleoptera, Hymenoptera, and Lepidoptera are without doubt neo-endemites. The Tibetan-Himalayan elements seem to represent Post-Pleistocene arrivals.

The Pleistocene survival. The Pliocene origin of the endemism of the nival insect fauna above the timber line in the NW. Himalaya involves considerations of the Pleistocene survival of the cold-adapted Pliocene endemites and other central Asian elements.

The Pleistocene survival of fauna is now an admitted fact. The older belief in the total destruction and migration of flora and fauna with the advancing Pleistocene ice has long ago been shown to be quite erroneous. Incredible numbers of species of both plants and animals were neither annihilated nor even did they migrate away from the glaciated areas, but have survived in the heavily glaciated areas in various parts of the world. Several workers like Erhard (36), Holdhaus (57-67), Lindroth (84, 85, 86, 87), Schweiger (126), Horion (69), Franz (43), and others have demonstrated the survival of different animals on the Alps. Recently Janetschek (75, 76) has brought together a mass of evidence for the survival of the boreo-alpine species in the heavily glaciated areas on the inner-alpine nunatak system. Even at the present time, surprising numbers of insects are in fact associated with the nunataks in Greenland and Antarctic ice sheets and in the Arctic Alaska.

in all of which places the Pleistocene conditions still continue to persist.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TOKYO
PEKING
KASHGAR
SRINAGAR
DELHI
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Fig. 55. Map of Asia and part of Europe, showing the areas which were glaciated at one time or another during the Pleistocene. (Equal area azimuthal projection, scale 1 : 4,000,000. *After Antevs,* 4).

The Pleistocene glaciations in Asia (Fig. 55) were small in comparison to those of Europe and North America. There were no great ice sheets comparable to those of Greenland and Antarctic ice of today, but only numerous ice-covered areas and extensive valley glaciers in mountains and plateaux. During the Pleistocene, general atmospheric aridity seems to have prevailed in large parts of the elevated areas of central Asia, more or less exactly as today. Ice covered the Pamir, Himalaya, Hindukush, Kuen-Lun, and the connecting ranges in Tibet and Sinkiang (Fig. 55). In Altai, the valley glaciers reached a length of about 320 kilometres and width of about 96 kilometres. There were large ice sheets in Pamir and in Kashmir. There are even at the present time nearly 1200 glaciers in the Pamir area, including some of the largest valley glaciers in the world. The Pamir Valley glaciers of Pleistocene were about 240 kilometres long. The ice sheet often attained a thickness of 150 metres in central Asia and Himalaya. The central Asian mountains like Alai (39° N., 70° E.), Tienshan, Alexander Mountains (43° N., 74° E.), Ala Tau Mts. (45° N., 80° E.) carried numerous valley glaciers. These glaciations are believed to have depressed the permanent snow line by 800 metres on the north slope and by 1600 metres on the south slope on the NW. Himalaya (4, 27, 89). Above the glaciers and ice sheets nunataks existed during the Pleistocene as they do today in these areas. As in Greenland, Antarctica, and the Himalaya at the present time, even during the maximum Pleistocene glaciation, high and massive rocky areas projected above the general mass of ice sheet and valley glaciers, bare and not covered by snow and ice, either because of the steepness, effects of wind, or because of various other local peculiarities. Such rock islands in the midst of ice and snow known as *nunataks* (from the Eskimo language), represent ecologically optimal islands or survival centres for flora and fauna, at present and during the Pleistocene.

Extensive nunatak systems and simultaneous adaptations to the changing conditions accounted for the survival of this fauna. The nunatak system was on a more massive scale than in the Alps. There were further large ice-free, dry, elevated and cold areas. According to Hutchinson (74), genera like *Dolmacoris* are, for example, not recent migrants, but the Heteropteran endemites have certainly survived the Quaternary glaciations in ice-free areas. Numerous ecologic and distributional peculiarities indicate such survival of the nival insect fauna on the nunataks. We have shown earlier (100) that the nival insects are bound to the seasonal snow cover, and it is justifiably conceivable that this was so even during the Pleistocene. The ability of genera like *Nysius* and *Chlamydatus* to survive in the vicinity of Pleistocene ice is referred to by Hutchinson (74). The pronounced massing of the nival species, especially the endemites, around high peaks and ridges, above the present permanent snow line and in areas, such as for example, the Pongong Valley, which were formerly heavily glaciated, and the concentrations in the neighbourhood of the present day glaciers are indications that these were the centres of the origin, evolution, and Pleistocene survival of the nival insect fauna. The Pliocene origin and

Pleistocene survival of endemites explain the lack of affinity to the Alps and the absence of the boreo-alpine type of distribution. While both the Alps and the Himalaya would seem to belong to the same Tertiary mountain system, their nival insect fauna have had totally different origins and histories. There has been no east-west faunal exchange. Hormuzaki (70, 71) has shown, for example, that even in the case of Lepidoptera, there has been no east-west exchange between Himalaya and the Alps, but the few species which are common to these areas are of northern origin. The differences in the Pleistocene glaciations of Europe and Asia would also account for some of these peculiarities. Not only is there no affinity between the nival insect fauna of the Alps and NW. Himalaya, but also in the Himalaya itself the endemism and faunal components of the NW. Himalaya are quite unrelated to those of the rest of the Himalaya, for example, Kumaon, Nepal, or Darjeeling Himalaya.

Rapid speciation. The high endemism and the occurrence of large numbers of local subspecies are evidence of the high phylogenetic plasticity and the intense speciation in the nival insect fauna of the NW. Himalaya. We have also found other direct evidence in the field in support of the high speed of speciation. We propose to discuss the subject in some detail on a future occasion. The extreme dynamism of the ecological conditions (100), recent geological, physiographical, topographical, and altitudinal changes, Pleistocene glaciations[1], isolation in small and localized allopatric patches on high massifs with intense potentialities for Sewall Wright phenomena (166), the phylogenetic youth and plasticity in spite of cold-specialization, and simultaneous appearance of variations in entire populations of an ecological niche are some of the major factors which govern the intense rate of speciation that is in progress among the nival insects at the present time. Even a minor topographic change, such as the damming of the River Chandra by the Bara Shigri Glacier about 180 years ago, so alters the ecological complex that a totally different type of allopatric population becomes rapidly differentiated. Many of the Pliocene endemites are at present developing local races and subspecies in a number of localities. In the montane tundra above the timber line in the NW. Himalaya there exists a high potential for rapid speciation. We are indeed witnessing still the birth of a unique new insect fauna on one of the largest, highest, and youngest elevated regions of the world.

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[1] The presence of a considerable proportion of neo-endemites is evidence of Pleistocene and Post-Glacial evolution. Petersen (118) has discussed the Pleistocene and Post-Pleistocene evolution in Holarctic fauna. Rand (122) has recently shown the importance of Pleistocene as an isolating factor in speciation.

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(*Concluded*)

The Birds of Nepal

PART 9

BY

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[*Continued from Vol.* **59** (3) : 821]

Family PARIDAE

Most of the specimens of this family listed below have already been dealt with by Vaurie (1950a).

*645. **Parus ater aemodius** Hodgson. Himalayan Coal Tit.

Scully (1879), Ripley (1950b), and we did not come across the Himalayan Coal Tit in Nepal. However, Proud (1949, p. 698) once observed it on Nagar Jong (*c.* 1830 m.), Nepal Valley, in December. It has subsequently been reported in central Nepal by Polunin (1955, p. 888) from the Langtang Valley at *c.* 3350 m. upwards in summer, and Lowndes (1955, p. 30) from Manangbhot at *c.* 2440-3655 m. in August. Rand & Fleming (1957, p. 115) recorded it in November from *c.* 2895 m. in the Kali Gandak Valley, west-central Nepal—the most westerly record for the subspecies. They also found it in Okhaldhunga District, eastern Nepal, at *c.* 3050 m. in winter. Biswas (1960a) reported it from Khumbu, eastern Nepal, at *c.* 3655-4265 m. between February and May.

646. **Parus major nipalensis** Hodgson. Nepal Grey Tit.

TARAI : Simra : 3 ♂♂, 1 unsexed (March 4, 5). BHABAR : Amlekhganj : 1 imm. ♂ (June 8). DUN : Hitaura : 1 ♂, 3 imm. ♂♂, 1 ♀, 2 imm. ♀♀, 1 unsexed, 1 imm. unsexed (May 11-26, June 18).

The Grey Tit is common in lower central Nepal from the tarai to the dun in light forests and forest edges, on bushes and trees, singly, in small flocks or in mixed feeding parties with other small birds.

Scully (1879, p. 323) found it in the Trisul Ganga Valley, central Nepal, in November, and Proud (1955, p. 57) occasionally in the

Nepal Valley in winter and spring. Ripley (1950b, p. 407) and Rand & Fleming (1957, p. 114) noted it from western through eastern Nepal from the tarai and dun up to the lower valleys, and Biswas (1960a) on the bank of Charnawati Khola, Ramechhāp District, eastern Nepal, in January.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	63, 64 +, 65, 65 +	55 (2), 60 (2)	11.5 (2), 12 (2)
1 ♀ :	61	53	12
2 unsexed[a] :	64, 65	58, 59	12 (2)

[a] Both these appear to be males.

647. **Parus monticolus monticolus** Vigors. Himalayan Greenbacked Tit.

Chitlang Valley : Chitlang : 1 ♂ (March 15). Nepal Valley : Thankot, Crest of Chandragiri : 6 ♂♂, 3 ♀♀ (March 21-24, April 16-20).

The Greenbacked Tit is common in central Nepal from about 1525 m. above. It is found in small parties or pairs, in open parts of forests on bushes and trees.

It has further been reported from the northern regions of central Nepal in summer by Polunin (1955, p. 888) in the Langtang Valley at *c.* 2745-3350 m., and Lowndes (1955, p. 30) in the Marsiyandi Valley, and Manangbhot at *c.* 1830-3655 m.; from western through eastern Nepal at *c.* 1220-3050 m. in winter by Rand & Fleming (1957, pp. 114-115). It was also once spotted by Biswas (1960a) at *c.* 3960 m. in Khumbu, eastern Nepal, in February.

It was breeding in March-April. A female dated April 17 had quite an enlarged ovary with the three largest ova measuring 2.5, 3, and 4 mm., in addition to a 7 mm. oviducal ovum without layers of albumen. A male taken April 20 had much swollen testes, R: 6×6, L: 6×5 mm.

Colours of soft parts : Iris dark brown ; bill black ; legs, feet and claws bluish slaty, horny black on tips of claws ; pads light grey.

Measurements :

	Wing	Tail	Bill
7 ♂♂ :	66, 68, 68.5, 69 (2), 69.5, 71	54, 56 (4), 57 (2)	11.5 (3), 12 (4)
3 ♀♀ :	67, 68, 70	53, 54, 56.5	12 (2), —

Baker (1922d, p. 80) has given 60-65 mm. as the wing length of the female. However, I measure the wing of 25 female specimens from western and central Himalayas (Murree to Nepal Valley) 63-71 mm. (average 66.9 mm.).

The population of the Greenbacked Tit from eastern Nepal and Sikkim was separated by Meinertzhagen (1926) as *lepcharum*. Ticehurst (1935, p. 40), and Kinnear (1937a, p. 23) did not recognize *lepcharum* and considered it indistinguishable from nominate *monticolus*. Vaurie (1950a, p. 37) accepted *lepcharum*, and placed the birds from the Nepal Valley, Sikkim, and Darjeeling District under it. After a careful comparison I find that the depth of green on the dorsal side and yellow on the ventral side varies clinally from western Himalaya eastward to China, the variation being very gradual and not very well marked, although the two extremes are quite distinct. It further appears that *lepcharum* consists of nothing more than intergrades between *monticolus* and *yunnanensis*. Many individual specimens from the intergrading zone (Nepal Valley to Bhutan) can be matched with *monticolus*, while many others can be matched equally well with *yunnanensis*—a fact also noted by Vaurie (op. cit., p. 36). I do not think any useful purpose will be served by recognizing such a poorly characterized race as *lepcharum*, and I would prefer to follow Ticehurst and Kinnear in considering it as a synonym of nominate *monticolus*. Recently, however, Vaurie (1957b, pp. 34-35) has agreed with this view. Still recently, Ripley (1961, p. 548) has also synonymized *lepcharum* with *monticolus*.

648. **Parus xanthogenys xanthogenys** Vigors. Western Blackspotted Yellow Tit.

Parus xanthogenys Vigors, 1831, *Proc. zool. Soc. Lond.* (1): 23. (Himalayas, restricted to Murree, West Pakistan, by Baker, 1920b, p. 236.)

DUN : Bhimphedi : 2 ♂♂ (March 12). MARKHU VALLEY : Deorali : 1 subad. ♂, 1 ♀ (April 28, May 2). CHITLANG VALLEY : Chitlang : 2 ♂♂ (April 23, 24). NEPAL VALLEY : Kathmandu, Phulchauki Danda above Godavari, Thankot, Chandragiri above Thankot : 5 ♂♂, 3 ♀♀ (March 22-30, April 9-11, May 13).

The Blackspotted Yellow Tit is common in central Nepal during March-May from *c*. 1220 m. upwards in small flocks or pairs in tree forests as well as in woods.

Ripley (1950b, p. 407), and Rand & Fleming (1957, p. 115) recorded it from western through eastern Nepal. Biswas (1960a) observed it in Bhota Kosi and Khimti valleys, eastern Nepal, at *c*. 1065-1830 m. early in February.

It was breeding in March, April, and May.

Colours of soft parts : Iris dark brown ; bill black, sometimes horny on tip ; legs, feet, and claws bluish slaty or horny slaty ; pads white.

Measurements :

	9 ♂♂	1 subad. ♂	4 ♀♀
Wing :	67, 68 (2), 70, 71.5, 72 (2), 73, 74	69 +	65, 66, 68, 71
Tail :	52 (2), 53, 54 (2), 55, 55.5, 56 (2)	50	50, 51, 52, 54
Bill :	12 (3), 12.5 (3), 13 (2), —	12	12 (2), 12.5 (2)

*649. **Parus xanthogenys spilonotus** Bonaparte. Eastern Blackspotted Yellow Tit.

The only records of the occurrence of this eastern race in Nepal are furnished by Hodgson's later collection (Gray, 1863, p. 37) presumably from eastern Nepal, and by Stevens (1923b, p. 725) from the Mai Valley, extreme eastern Nepal, at *c.* 2135-2440 m. in March-April.

*650. **Parus rubidiventris rufonuchalis** Blyth. Simla Black Tit.

The sole record of the occurrence of the Simla Black Tit in Nepal is furnished by Rand & Fleming (1957, p. 116) on a single example, obviously a stray one, taken in winter in the Kali Gandak Valley, west-central Nepal, at *c.* 2805 m., within the range of nominate *rubidiventris.*

Vaurie (1950a, pp. 41-44) has discussed at length the advisability of uniting the blackbellied forms (formerly *P. rufonuchalis* and races) with the rufousbellied *P. rubidiventris.* Dr. Walter Koelz, however, informs me (*in litt.*) that he had seen both of them together in Garhwal and Kumaon, although he did not collect any blackbellied example there.

*651. **Parus rubidiventris rubidiventris** Blyth. Rufousbellied Crested Tit.

Since Hodgson's days, the Rufousbellied Crested Tit has been recorded from Nepal by Smythies (1948, p. 439), and Proud (1952a, p. 362) in the Gandak-Kosi watershed between *c.* 3050 and 3960 m., Polunin (1955, p. 888) in the Langtang Valley at *c.* 3200-3960 m., and Lowndes (1955, p. 30) in Manangbhot at *c.* 2440-3960 m.—all in northern central Nepal; and by Rand & Fleming (1957, p. 116) in the Kali Gandak Valley, west-central Nepal, at *c.* 2805 m.

*652. **Parus rubidiventris beavani** (Jerdon). Sikkim Black Tit.

The post-Hodgsonian records of the Sikkim Black Tit from Nepal consist of Ripley's (1950b, p. 407) in the Tamur Valley, eastern Nepal, at *c.* 2745 m. in winter, and Biswas's (1960a) in Khumbu, eastern Nepal, at *c.* 3655-4265 m. between March and May.

*653. **Parus dichrous dichrous** Blyth. Brown Crested Tit.

Scully (1879), Ripley (1950b), and we were unable to find the Brown Crested Tit in Nepal. It has, however, been reported from the Kali Gandak Valley, west-central Nepal, at *c.* 3655 m. in December by Rand & Fleming (1957, p. 116), from the northern regions of central Nepal by Smythies (1948, p. 440), and Proud (1952a, p. 362) in the Gandak-Kosi watershed between *c.* 3350 and 3655 m., Polunin (1955, p. 888) in the Langtang Valley at *c.* 3350 m., and Lowndes (1955, p. 30) in Manangbhot at *c.* 3050 m., and from eastern Nepal by Rand & Fleming (loc. cit.) in Okhaldhunga District at *c.* 2895 m. in winter, and Biswas (1960a) in Khumbu at *c.* 3655-3960 m. between February and May.

Snow (in Vaurie, 1957b, pp. 39-40) has shown that *izzardi* Biswas, 1955, is a synonym of nominate *dichrous*.

654. **Sylviparus modestus modestus** (Burton). Eastern Yellowbrowed Tit.

MARKHU VALLEY : Deorali : 1 ♀ (April 28). CHITLANG VALLEY : Chitlang, Chandragiri above Chitlang : 3 ♂♂, 2 ♀♀, 1 unsexed (March 15, April 18-27). NEPAL VALLEY : Thankot, Crest of Chandragiri : 4 ♂♂, 3 ♀♀ (March 23-April 15).

The Yellowbrowed Tit is not particularly common in central Nepal during March-May. We found it at *c.* 1525-2440 m. in small flocks in open parts of forests on bushes, small trees, and lower branches of large trees.

Smythies (1948, p. 440) recorded it from the Gandak-Kosi watershed at *c.* 4265 m. in autumn. Except Ripley's (1950b, p. 407) report from eastern Nepal, it has been known in Nepal only from its central region.

It was breeding in April. Two females taken April 15 and 18 had well-developed ovaries.

Colours of soft parts : Iris dark brown ; upper mandible dark horny, bluish slaty on base and greyish white on the sides of its anterior half ; lower mandible bluish slaty with dark tip and greyish white on the sides of its anterior half ; legs, feet and claws bluish slaty ; pads greyish white.

Measurements :

	7 ♂♂	6 ♀♀	1 unsexed
Wing:	57, 58.5, 60, 60.5, 62 (2), 63	55.5, 56, 56.5, 57 (2), 58	62
Tail:	35, 36, 37, 38, 40 (2), 41	34 (2), 35, 36, 37, 39	41
Bill:	9 (5), 9.5, 10	9 (4), 9.5, 10	9.5

655. **Melanochlora sultanea sultanea** (Hodgson). Indian Sultan Tit.

DUN : Hitaura : 1 ♂ (May 24).

The Sultan Tit was noted by us to be a rare bird in central Nepal, having been found only once in the forest at Hitaura in the dun. Ripley (1950b, p. 408) observed it only once in the eastern Nepal tarai, and Rand & Fleming (1957) found none. However, 80 years ago Scully (1879, p. 324) found it 'fairly common in December' between Nimboatar and Hitaura in the central dun.

Measurements : 1 ♂ : Wing 113 ; tail 94 ; bill 18.

*656. **Aegithalos iouschistos iouschistos** Hodgson. Rufousfronted Tit.

Neither Scully (1879) nor we came across the Rufousfronted Tit in Nepal. Of the post-Hodgsonian records of the species from Nepal, except Proud's (1952a, p. 362) sighting in the Gandak-Kosi watershed at *c.* 2745-3655 m. in spring, it has been found only in eastern Nepal (Stevens, 1923b, p. 724; Ripley, 1950b, p. 408; Rand & Fleming, 1957, p. 118; and Biswas, 1960a).

657. **Aegithalos concinnus iredalei** (Baker). Himalayan Redheaded Tit.

DUN : Bhimphedi : 1 ♂ (March 13). MARKHU VALLEY : Deorali : 1 unsexed (April 29). CHITLANG VALLEY : Chitlang, Chandragiri above Chitlang : 2 ♂♂, 2 imm. ♂♂, 2 ♀♀, 2 unsexed, 1 imm. unsexed (March 15, April 19-24). NEPAL VALLEY Godavari, Thankot, Chandragiri above Thankot, Crest of Chandragiri : 9 ♂♂, 4 ♀♀, 1 imm. unsexed (March 21-April 16, May 11).

The Redheaded Tit is common in central Nepal between *c.* 1370 and 2285 m. It occurs in small flocks in open parts of forests on bushes and trees.

It has been reported from western Nepal by Ripley (1950b, p. 407) and Rand & Fleming (1957, p. 117); from the northern region of central Nepal by Polunin (1955, p. 888); and from eastern Nepal by Stevens (1923b, pp. 723-724), Rand & Fleming (op. cit., p. 118) and Biswas (1960a).

It was breeding in late March and April.

Colours of soft parts : Iris yellowish white ; bill black ; legs and feet orange brown or brownish yellow ; claws pale horny or brownish horny ; pads fleshy yellowish fleshy or white.

Measurements :

	12 ♂♂	6 ♀♀	3 unsexed
Wing :	52 (4), 52.5 (2), 53 (2), 54 (2), 55 (2)	49 (2), 50 (2), 51, 52	50, 51, 51+
Tail :	50.5, 51 (3), 52(2), 52.5, 53 (2), 55(2), 58	45, 47, 48, 49, 49.5, 50	49+, 50 (2)
Bill :	8, 9 (8), 9.5 (2),—	8.5 (4), 9 (2)	8.5, 9 (2)

Of late there has been some difference of opinion as to the validity of an eastern Himalayan race, *rubricapillus* Ticehurst. While Ripley (loc. cit., and 1961, p. 555), and Rand & Fleming (loc. cit.) admit *rubricapillus*, Vaurie (1950a, p. 65, and 1957c, pp. 15-16) does not recognize it. It would appear that this difference of opinion is due to the fact that when individual specimens or small series are compared, *rubricapillus* appears distinct. In large series such as that present in the British Museum, however, the differences between the western and eastern Himalayan populations are reduced to insignificant proportion, leaving, to quote Snow (in Vaurie, 1957c, p. 16) 'many many birds [that] are not separable'. To me it appears inadvisable to accept *rubricapillus*, especially 'as other subspecies of this species are rather distinct, it seems doubly undesirable to admit this poorly marked form' (Snow, in Vaurie, loc. cit.).

*658. **Cephalopyrus flammiceps olivaceus** Rothschild. Eastern Firecapped Tit.

Although Nepal lies within the range of the species, I am unable to trace any definite record of the Firecapped Tit from that country, except Gadow's (1883, p. 70) entry of a single specimen as 'Nepal Purchased'.

Family SITTIDAE

Subfamily SITTINAE

659. **Sitta castanea almorae** Kinnear & Whistler. Western Cinnamonbellied Nuthatch.

TARAI: Simra: 1 ♂ (March 5). BHABAR: Amlekhganj: 2 ♂♂, 1 (♀), 1 subad. ♀ (March 6-9). DUN: Hitaura, Bhimphedi: 9 ♂♂, 2 imm. ♂♂, 1 ♀, 1 subad. (♀), 3 imm. unsexed (May 13-June 19). NEPAL VALLEY: Pashupatinath, Phulchauki Danda above Godavari, Thankot: 3 ♀♀ (March 22, April 11, May 13).

The Cinnamonbellied Nuthatch is a common bird of central Nepal. We found it more numerous in the dun during May-June than in the tarai and bhabar in early March or in the Nepal Valley during March-May. It occurs usually in pairs, but sometimes singly, on trees in forests and woods.

Rand & Fleming (1957, p. 118) recorded it from west-central to eastern Nepal.

In the Nepal Valley it was breeding in April and early May. A female taken April 11 was actually laying, having a 10 mm. oviducal egg without shell. By late May breeding was over in the duns, for specimens taken then or in June had spent up ovaries and reduced testes.

Colours of soft parts: Iris dark to reddish brown; upper mandible black with bluish slaty on base; lower mandible bluish slaty with black anterior quarter; legs, and feet slaty horny; claws horny; pads grey-white to white.

Measurements:

	Wing	Tail	Bill
12 ♂♂:	81, 83 (3), 84(4), 84.5, 85 (3)	41, 42 (3), 43 (5), 44, 47,—	22.5 (3), 23 (4), 23.5 (3), 24 (2)
6 ♀♀:	79, 82, 83 (2), 84, 84.5	40, 41, 42, 43, 45, 48	22 (3), 22.5, 23 (2)

The specimens from central Nepal are somewhat intermediate between the western *almorae* and the eastern *cinnamoventris* Blyth (type locality Darjiling), but closer to the former, as has already been shown by Vaurie (1950b, p. 6). Ripley (1950b, p. 408) placed his birds under *cinnamoventris*, while Rand & Fleming (1957, pp. 118-119) followed Vaurie in designating their specimens from west-central, central, and eastern Nepal as *almorae*. Recently, Ripley (1961, p. 558) has given the range of *almorae* eastward up to east-central Nepal (presumably Kamala Valley, Mahotari District, where Rand & Fleming's single eastern specimen was taken) where it has been said to intergrade with the eastern race *cinnamoventris* whose western limit has been given as eastern Nepal. Since I cannot trace any definite record of the occurrence of *cinnamoventris* in Nepal, I am not listing it in this paper.

*660. **Sitta castanea castanea** Lesson. Chestnutbellied Nuthatch.

The sole record of the occurrence of the Chestnutbellied Nuthatch in Nepal has been provided by Ripley's (1950b, p. 408) specimens taken in the western tarai and central plains during winter.

661. **Sitta himalayensis himalayensis** Jardine & Selby. Himalayan Whitetailed Nuthatch.

DUN : Bhimphedi : 1 imm. ♂, 1 imm. unsexed (May 6, 8). MARKHU VALLEY : Deorali : 1 ♂ (May 1). CHITLANG VALLEY : Chitlang, Chandragiri above Chitlang : 4 ♂♂, 1 imm. ♂, 2 ♀♀, 1 imm. ♀ (March 15, April 17-20). NEPAL VALLEY : Thankot, Crest of Chandragiri : 4 ♂♂, 3 ♀♀ (March 21-April 15).

The Whitetailed Nuthatch is common in central Nepal from *c.* 1370 to 2285 m., and probably further upward. It is found singly or in pairs on trees in forests.

In west-central Nepal it has been reported by Rand & Fleming (1957, p. 118) from the Kali Gandak Valley at *c.* 1830 m. in winter; in northern central Nepal by Proud (1952a, p. 362) from the Gandak-Kosi watershed up to *c.* 2895 m. in spring, and Polunin (1955, p. 888) from the Langtang Valley at *c.* 2440-2745 m. in summer; and in eastern Nepal by Stevens (1924a, p. 1008) from the Mai Valley at *c.* 2590 m. in April, Ripley (1950b, p. 408) from the Tamur Valley in winter, and Rand & Fleming (loc. cit.) from the Maulung and Dudh Kosi valleys at *c.* 2285 and 3050 m. in winter.

March and April birds were all breeding.

Colours of soft parts : Iris brown ; upper mandible horny black with ashy on base of culmen ; lower mandible pale bluish white with horny black tip ; legs, feet, and claws horny brown ; pads greyish white.

Measurements :

	9 ♂♂	5 ♀♀
Wing :	71, 72 (2), 73, 74, 75(2), 76,—	72(2), 72.5, 73,—
Tail :	35, 36 (2), 36.5, 37, 38 (3), 41	35(2), 36, 37.5, 38
Bill :	16.5, 17 (4), 17.5 (2), 18 (2)	16.5, 17 (3), 18

662. **Sitta frontalis frontalis** Swainson. Velvetfronted Nuthatch.

Tarai : Simra : 4 ♂♂ (March 4, 5). Dun : Hitaura, Bhimphedi : 3 ♂♂, 1 imm. ♂, 3 ♀♀, 1 imm. unsexed (May 5-28, June 15).

The Velvetfronted Nuthatch is not uncommon in the dun and tarai of central Nepal. It occurs in pairs or small parties on trees in the forests. We had not been able to locate it in the Nepal Valley where Ripley (1950b, p. 408), Smythies (1950, p. 513), and Rand & Fleming (1957, p. 119) observed it. Scully (1879) did not find it in Nepal. Rand & Fleming recorded it also from western, west-central and eastern Nepal.

The unsexed juvenile specimen (May 11) has some spots on the anterior crown.

The June 15 specimens are very worn but there is no sign of moult.

Measurements :

	Wing	Tail	Bill
7 ♂♂ :	72, 72.5 (2), 74, 75 (2), 77	39 (2), 40 (2), 40.5, 41, 43	15.5 (2), 16 (3), 16.5,—
3 ♀♀ :	69, 72, 72.5	36.5, 37, 38	15.5, 16, 16.5

I agree with Vaurie (1950b, pp. 11-13) that *corallina* Hodgson (type locality Nepal) cannot be upheld.

Subfamily TICHODROMADINAE

*663. **Tichodroma muraria nepalensis** Bonaparte. Himalayan Wall Creeper.

Scully (1879, p. 262) recorded the Himalayan Wall Creeper in the Nawakot District and the Nepal and Markhu valleys during winter, 'but not in any great numbers'. Stevens (1924a, p. 1011) found it on the Nepal side of the Singalila Range, eastern Nepal, near Sandakphu at *c.* 3597 m. in March. Proud (1949, p. 699) noted it once on Sheopuri, Nepal Valley. Ripley (1950b, p. 409) sighted it once in eastern Nepal at *c.* 1980 m. in February. Polunin (1955, p. 890) recorded it from the Langtang Valley, central Nepal, at *c.* 2745 m. in summer. Rand & Fleming (1957, p. 121) found it from west-central through eastern Nepal at *c.* 550-2745 m. in winter.

Family CERTHIIDAE

*664. **Certhia familiaris mandellii** Brooks. Mandelli's Tree Creeper.

Gadow's (1883, pp. 328-329) lists of specimens under '*Certhia discolor*' and '*Certhia nipalensis*' are a curious mixture of *C. familiaris mandellii*, *C. nipalensis*, and *C. discolor*. Thus, under *C. nipalensis* (with *C. mandellii* as a synonym), he enters six specimens from Nepal, four from Hodgson's collection and two from Gould's and under *C. discolor* (with *C. stoliczkae* as a synonym), two specimens ex Gould collection from Nepal are listed. In point of fact, however, *C. mandellii* has nothing to do with *C. nipalensis*, being accepted as a subspecies of *C. familiaris*, and *C. stoliczkae* in its turn is no close relation of *C. discolor*, being only a synonym of *C. nipalensis*.

The first definite record of Mandelli's Tree Creeper from Nepal was made by Smythies (1948, p. 440) from the Gandak-Kosi watershed, central Nepal, at *c.* 3505 m. in autumn, followed by Proud (1949, p. 699) from the Nepal Valley at above 1980 m. Both these are, however, visual records. The first post-Hodgsonian specimens taken in Nepal are Ripley's (1950b, p. 409) from the Tamur Valley, eastern Nepal, at *c.* 2745 m. in winter. It was subsequently reported from central Nepal by Proud (1952a, p. 363) in the Gandak-Kosi watershed at *c.* 2440-3505 m. in spring, Polunin (1955, p. 890) in the Langtang Valley at *c.* 3350-3960 m. in summer, and Lowndes (1955, p. 31) in Manangbhot at *c.* 3350-4115 m. in summer; from west-central Nepal by Rand & Fleming (1957, p. 119) in the Kali Gandak Valley at *c.* 3655 m. in winter; and in eastern Nepal by Rand & Fleming (loc. cit.) in the Maulung Valley at *c.* 3505 m. in December, and Biswas (1960a) in Khumbu at *c.* 3655-3960 m. between February and May.

*665. **Certhia nipalensis** Blyth. Nepal Tree Creeper.

Scully (1879), and we were unable to find the Nepal Tree Creeper in Nepal. Stevens (1924a, p. 1010) came across it on the Singalila Range, eastern Nepal, at *c.* 2745-3505 m. between January and May—a fact apparently overlooked by Ripley (1950b, p. 409) when in reporting his single specimen from the Tamur Valley, eastern Nepal, he said that the only earlier Nepali record of the species was Hodgson's. Rand & Fleming (1957, p. 120) found it not only in eastern Nepal (Maulung Valley) at *c.* 3505 m. but also in west-central (Ulleri) at *c.* 2440 m. in December. This last constitutes the most westerly record known for the species.

Regarding the early Nepali collections of this species, see under *C. familiaris mandellii* (p. 181).

*666. **Certhia himalayana infima** Ripley. Dark Himalayan Tree Creeper.

The Dark Himalayan Tree Creeper was not included in the catalogues of Hodgson's collections (Gray & Gray, 1846; Gray, 1863), but Gadow (1883, p. 328) listed two specimens in the British Museum presented by Hodgson. Since Hodgson's days it was not known from Nepal, until Ripley (1950a, p. 106; 1950b, pp. 408-409) collected it from the western tarai in winter, and separated the Nepal population from the farther western Himalayan birds. It has also been obtained by Rand & Fleming (1957, p. 121) from western Nepal at *c.* 1065 and 1830 m. in winter.

Vaurie (1959a, pp. 544-545) does not recognize *infima* as distinct from the nominate *himalayana*.

667. **Certhia discolor discolor** Blyth. Sikkim Tree Creeper.

CHITLANG VALLEY : Chitlang : 1 ♂ (April 23).

This Tree Creeper appeared to be scarce in central Nepal where we found it only on two occasions, once on Chandragiri near Chitlang, when the specimen was collected, and again on Phulchauki Danda above Godavari at about 1830 m. on May 13.

Reporting on our specimen, Vaurie (1950b, pp. 38-39) remarked that this was the first specimen that was undoubtedly taken in Nepal. Subsequently, however, examples were collected in the Nepal Valley by Ripley (1950b, p. 409), and in western through central Nepal by Rand & Fleming (1957, p. 120). Earlier, Smythies (1950, p. 515) observed Tree Creepers at *c.* 2135-2440 m. on Sheopuri Range, which he recorded as *C. discolor*.

Regarding the early Nepali collections of this species, see under *C. familiaris mandellii* (p. 181).

Our specimen was breeding.

In pointing out certain variations in colour of their Nepal specimens from northern Bengal, Rand & Fleming (loc. cit.) commented that Vaurie (loc. cit.) did not note those differences. However, no critical comparison was possible between the Nepal specimen and the specimens from Sikkim-Darjeeling, since, as Vaurie (op. cit., p. 39) has distinctly noted that 'The Nepal bird is very worn while the plumage is fresh in the others'.

Measurements : 1 ♂ : Wing 72 ; tail 77+; bill 17.5.

Family DICAEIDAE

*668. **Dicaeum agile agile** (Tickell). Thickbilled Flowerpecker.

Scully (1879, p. 260) was the first to report the occurrence of this species of flowerpecker in Nepal. He found it 'not uncommon in the central part of the Nepal Valley, from May to September'. We were, however, unable to locate it in central Nepal. Proud (1949, p. 713) noted it to be very common in the Nepal Valley up to *c.* 2135 m. from summer to autumn. Ripley (1950b, p. 410) found it in the eastern tarai and dun in winter. Polunin (1955, p. 895) reported it from the Trisul Valley, central Nepal, in summer. Rand & Fleming (1957, p. 198) recorded it in the western tarai and central plains in winter.

*669. **Dicaeum chrysorrheum chrysorrheum** Blyth. Yellowvented Flowerpecker.

The lone record of the Yellowvented Flowerpecker from Nepal is based on Hodgson's collection (Gray, 1863, p. 26; Sharpe, 1885, p. 44).

670. **Dicaeum melanozanthum** (Blyth). Yellowbellied Flowerpecker.

NEPAL VALLEY : Thankot : 1 ♂, 1 subad. ♂ (April 2).

This flowerpecker appeared rather scarce in central Nepal. We came across it only occasionally in pairs on tall trees in open parts of forests. It was not included by Scully (1879), and Ripley (1950b) in their lists. Lowndes (1955, p. 35) reported it from the Marsiyandi Valley, central Nepal, at *c.* 2440 m. in August. Proud (1955, p. 69) found it occasionally during December-February in the Nepal Valley where Rand & Fleming (1957, p. 198) took a single specimen in March.

Measurements :

	Wing	Tail	Bill
1 ♂ :	71	41	11
1 subad. ♂ :	70	37	11.5

671. **Dicaeum erythrorhynchos erythrorhynchos** (Latham). Tickell's Flowerpecker.

TARAI : Simra : 1 ♂, 1 ♀ (March 4).

This flowerpecker is not a common bird of central Nepal. We found it in pairs in the tarai in tree-groves growing in open country.

Scully (1879) did not report it from Nepal. Proud (1949, p. 713) noted it as common in the Nepal Valley all summer. Ripley (1950b, p. 409) came across it in the western and central tarai, and Rand & Fleming (1957, p. 197) in the western through eastern lowland in winter.

Measurements :

	Wing	Tail	Bill
1 ♂ :	46	23	12
1 ♀ :	47.5	24	13

Rand & Fleming (loc. cit.) questioned the validity of the statement by Mayr & Amadon (1947, p. 19) that this species 'is a close relative of *concolor* and so similar to it that occasional specimens may not be identifiable'. Although not clearly indicated, Mayr & Amadon referred in all probability to living birds in the field. Indeed, *D. concolor* and *D. erythrorhynchos* are exceedingly similar in their habits, call, and general appearance, and they are easily and frequently mistaken in the field, unless particular attention is paid to the colour of the bill, which is blackish in the first-named species but pale yellowish or fleshy in the other. This again is not always possible to note accurately, for it depends to a large extent on the distance between the observer and the bird, restlessness of the bird, and the direction of the light.

672. **Dicaeum concolor olivaceum** Walden. Plaincoloured Flowerpecker.

DUN : Hitaura : 6 ♂♂, 3 ♀♀ (May 13-28, June 19, July 9).

The Plaincoloured Flowerpecker is not uncommon in the central dun. It occurs in pairs, sometimes several pairs feeding together, on large trees and tree-groves growing in open country.

Scully (1879) did not find it in Nepal, but Ripley (1950b, p. 409), and Rand & Fleming (1957, p. 198) collected it in the Nepal Valley.

Measurements :

	Wing	Tail	Bill
6 ♂♂ :	44(2), 45(2), 46, 47	21(2), 22(2), 23(2)	11.5, 12(5)
3 ♀♀ :	43, 44(2)	22(3)	11, 11.5, 12

*673. **Dicaeum cruentum cruentum** (Linnaeus). Scarletbacked Flowerpecker.

Hodgson's collection furnishes the only record of the Scarletbacked Flowerpecker for Nepal.

674. **Dicaeum ignipectus ignipectus** (Blyth). Firebreasted Flowerpecker.

DUN : Bhimphedi : 3 ♂♂, 2 ♀♀ (March 11, 13). CHITLANG VALLEY : Chitlang : 1 ♀ (April 18). NEPAL VALLEY : Thankot, Crest of Chandragiri : 7 ♂♂, 6 ♀♀, 1 (♀), 1 imm. ♀ (March 22-April 16).

The Firebreasted Flowerpecker is common in central Nepal, especially in the forests on the bases of the hills surrounding the Nepal Valley. It occurs in pairs in bushes as well as on trees.

Polunin (1955, p. 894) found it in the Langtang Valley, northern central Nepal, at *c.* 2745 m. in summer. Rand & Fleming (1957, pp. 197-198) recorded it from west-central to eastern Nepal at *c.* 915-2285 m. in winter.

The juvenile specimen (♀, April 9) has chin and throat white, and the buff on the underside much paler and duller than that of adult.

March and April birds were breeding. A female taken March 23 was marked 'laying' on its label.

Colours of soft parts : Iris brown to dark brown ; bill black with a patch on the base of lower mandible—whitish in male but yellow to orange in female ; legs, feet, and claws dark horny, sometimes black on the claws ; pads greyish white.

Measurements :

	10 ♂♂	10 ♀♀
Wing :	47(2), 48, 49(5), 51(2)	45, 46(5), 47(3), 48
Tail :	25(4), 26(3), 27(2), 28	23, 24(5), 25(2), 26, —
Bill :	10, 10.5, 11(6), 11.5, 12	10, 10.5(3), 11(2), 11.5,—(3)

Family NECTARINIIDAE

*675. **Anthreptes singalensis rubinigentis** (Baker). Indian Rubycheek.

Ripley's (1950b, p. 410) collection of a single specimen in the eastern tarai forms the sole record of the occurrence of the Indian Rubycheek in Nepal.

As I have pointed out elsewhere (Biswas, 1963, in press[1]), Baker's name *rubinigentis* should be used for the Indian Rubycheek.

676. **Nectarinia asiatica asiatica** (Latham). Purple Sunbird.

TARAI : Simra : 1 ♀ (March 6). BHABAR : Amlekhganj : 2 ♂♂ (March 6, 8). DUN : Hitaura, Bhimphedi : 1 ♂, 1 ♀ (March 11, May 28). NEPAL VALLEY : Kathmandu : 1 subad. ♂, 1 juv. ♂, 2 ♀♀ (July 23, 24).

The Purple Sunbird is not uncommon in central Nepal in gardens, on hedges, bushes, and smaller trees about villages and edges of forests.

Ripley (1950b, p. 410) found it in eastern Nepal, and Rand & Fleming (1957, pp. 194-195) in western and west-central Nepal also.

The subadult male specimen (July 23) corresponds with the description of the eclipse plumage given by Whistler (in Ali, 1936b, p. 773). The black stripe on its underside is with very little gloss, but there is a greenish wash on the dorsal side, and the ventral side is yellow.

The juvenile male specimen (July 23) has merely an indication of black throat stripe.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	54[a], 56, 57(2)	31[a], 35, 37, 38	20[a], 20.5, 21.5(2)
4 ♀♀ :	51.5, 52.5, 53, 54	30(2), 31, —	20(2), 20.5, —

[a]Subadult

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[1] Comments on Ripley's A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN, to be published in *J. Bombay nat. Hist. Soc.*

*677. **Aethopyga gouldiae gouldiae** (Vigors). Mrs. Gould's Sunbird.

Although not listed in any of the catalogues of Hodgson's collections, Sharpe (1884, p. 28) traced a single specimen of Mrs. Gould's Sunbird in the British Museum from Nepal presented by Hodgson. The only other record of this sunbird from Nepal appears to be Biswas's (1960a) sight record from eastern Nepal in the Bhote Kosi Valley at *c.* 3655 m. in February-May, the Dudh Kosi Valley at *c.* 3050 m. in June, and the Hongu Valley at *c.* 3350-3655 m. in June.

*678. **Aethopyga nipalensis horsfieldi** (Blyth). Blyth's Yellowbacked Sunbird.

Blyth's Yellowbacked Sunbird is known from Nepal only through Ripley's (1950b, p. 410) collection from the western tarai, and Rand & Fleming's (1957, p. 195) record from western and west-central Nepal at *c.* 1065-1830 m. in November-December. The west-central specimens are, however, intermediate between *horsfieldi* and the eastern nominate *nipalensis.*

679. **Aethopyga nipalensis nipalensis** (Hodgson). Nepal Yellowbacked Sunbird.

CHITLANG VALLEY : Chitlang : 5 ♂♂, 1 ♀ (April 15-26). NEPAL VALLEY Thankot, Crest of Chandragiri : 9 ♂♂, 9 ♀♀ (March 21-April 14).

The Yellowbacked Sunbird was found common in central Nepal between *c.* 1525 and 2285 m. during March-April on bushes, shrubs, etc., especially those with flowers. Several pairs of them were frequently found feeding together.

It has been reported from central Nepal in the Chandragiri Pass by Smythies (1950, p. 516), the Gandak-Kosi watershed at *c.* 2440-2745 m. in spring by Proud (1952a, p. 363), the Langtang Valley up to *c.* 3505 m. in summer by Polunin (1955, p. 894), and the Marsiyandi Valley at *c.* 1980-2440 m. in September by Lowndes (1955, p. 35); and from eastern Nepal by Ripley (1950b, p. 410) in the Tamur Valley at *c.* 2745 m. in winter, and Rand & Fleming (1957, p. 195) in Okhaldhunga District at *c.* 305 and 2285 m. in December.

Colours of soft parts : Iris reddish brown ; legs, feet, and claws dark horny; pads grey.

Measurements :

	14 ♂♂	10 ♀♀
Wing :	51 (2), 52, 53, 54 (3), 55 (2), 56 (2), 57 (2), 58	47, 48 (3), 49 (2), 49.5, 50, 51, 52
Tail :	61, 63, 64 (3), 65, 66, 67, 70 (3),—(3)	42 (2), 43 (2), 44 (2), 45 (2), 46, 49
Bill :	20.5, 21 (2), 22 (2), 22.5 (2), 23, 23.5,—(5)	20 (4), 20.5, 21 (2), 21.5, 22,—

680. **Aethopyga saturata saturata** (Hodgson). Blackbreasted Sunbird.

Dun: Hitaura, Bhimphedi: 5 ♂♂ (March 11, 13, May 4-16). Chitlang Valley: Chitlang: 1 juv. ♂ (April 26). Nepal Valley: Thankot: 3 ♂♂, 1 ♀ (March 30-April 8).

The Blackbreasted Sunbird is not uncommon in central Nepal from about 455 m. up to some 1830 m. It is found mostly on bushes in the forests.

Scully's (1879) list does not include this species. Rand & Fleming (1957, p. 196) have also recorded it from western and west-central Nepal at *c.* 455 and 760 m. in winter.

One of my male examples (Thankot, March 31) has no yellow on the rump.

Measurements :

	Wing	Tail	Bill
8 ♂♂ :	53, 54 (3), 55 (3), 57	70, 73 (2), 76 (2), 79, 80,—	20 (2), 21 (2), 21.5 (2), 22,—
1 ♀ :	49	—	22

681. **Aethopyga siparaja seheriae** (Tickell). Indian Scarletbacked Sunbird.

Bhabar: Amlekhganj: 5 ♂♂, 1 juv. ♂, 1 ♀ (March 6-8). Dun: Hitaura, Paharé Ghat, Bhimphedi: 9 ♂♂, 5 ♀♀ (March 11, 13, May 18-30, June 11-18). Nepal Valley: Thankot: 1 ♂, 1 ♀ (March 26, 29).

The Scarletbacked Sunbird is common in central Nepal, especially in the bhabar and dun.

Scully (1879) did not find it in Nepal. Ripley (1950b, p. 410) reported it from western Nepal, and Rand & Fleming (1957, p. 196) from western, west-central, and eastern Nepal up to *c.* 1370 m. in winter.

Two of my female specimens taken March 8 and 11 have their forecrowns in moult.

Two male specimens taken June 11 and 18 had breeding testes measuring, respectively, 6×6 (each), and R: 6×5, L: 5×5.

Colours of soft parts : Iris dark brown ; upper mandible dark horny, black on posterior third ; lower mandible horny brown ; legs, feet, and claws dark horny ; pads greyish or yellowish white.

Measurements :

	15 ♂♂	7 ♀♀
Wing :	56 (2), 56.5, 57 (5), 57.5, 58 (2), 59, 59.5, 60 (2)	49, 50 (2), 51(4)
Tail :	62 (2), 64 (3), 66, 69, 70, 71 (2), 73,—(4)	34, 35 (2), 36, 38 (2), 39
Bill :	20, 20.5 (2), 21 (7), 21.5, 22,—(3)	19.5, 20 (4), 20.5, 21

Baker (1926, p. 378) did not recognize Hodgson's *miles* from Nepal on the basis of Hodgson's ancient skins, although they were dull grey on the underside. Ticehurst (1927a, p. 355), however, upheld *miles* saying that the 'Nepal birds (*miles*) stand out rather prominently with dull grey under parts'. He apparently ignored the fact that Hodgson's skins were then about 90 years old (and for some years they were kept in the tropics). Baker (loc. cit.) had also cautioned about the peculiar coloration of those skins by saying that it may be 'due . . . to his [Hodgson's] method of curing the skins'. I accept Baker's opinion on the status of *miles*, for all fresh skins of the species (Col. Bailey's at the British Museum, and ours) are not separable from *seheriae*. Rand & Fleming (loc. cit.) have arrived at the same conclusion.

682. **Aethopyga ignicauda ignicauda** (Hodgson). Firetailed Sunbird.

DUN : Bhimphedi : 2 ♂♂, 1 ♀ (March 13, 14). CHITLANG VALLEY : Chitlang : 1 ♂ (March 15). NEPAL VALLEY : Thankot : 2 ♂♂, 4 ♀♀ (March 22-31).

The Firetailed Sunbird was occasionally found by us in central Nepal during March and early April on bushes or shrubs with flowers at elevations over 1525 m. In the Nepal Valley we did not find them after the first week of April, they evidently having gone up to their breeding grounds.

Ripley (1950b, p. 410) found it in the Tamur Valley, eastern Nepal at *c.* 1525 m. in winter. Polunin (1955, p. 894) reported it from the Langtang Valley, central Nepal, at *c.* 3050 m. in summer. Rand & Fleming (1957, pp. 196-197) recorded it from west-central through eastern Nepal at *c.* 1370-2895 m. in winter. Biswas (1960a) came across it occasionally in Khumbu, eastern Nepal, at *c.* 3050-3655 m. between February and May.

Most of our specimens are in different stages of moult from eclipse to breeding plumage, but nearing completion.

Measurements:

	Wing	Tail	Bill
5 ♂♂:	57, 58 (4)	moulting (5)	21.5, 23,—(3)
5 ♀♀:	53, 54, 55 (3)	40 (2), moulting (3)	21, 22 (2),—(2)

683. **Arachnothera magna magna** (Hodgson). Indian Streaked Spiderhunter.

DUN : Hitaura : 2 ♀♀ (June 21, 27).

The Streaked Spiderhunter appeared scarce in central Nepal, having been found by us only two or three times about Hitaura. Our two specimens referred to above are the only ones obtained in Nepal since Hodgson's time.

Measurements: 2 ♀♀ : Wing 84 (2); tail 44, 45; bill 41, 42.

Family Zosteropidae

684. **Zosterops palpebrosa palpebrosa** (Temminck & Schlegel). Eastern White-eye.

Tarai : Simra : 1 ♀ (March 6). Bhabar : Amlekhganj : 2 ♀♀ (March 6, 8). Dun : Hitaura, Bhimphedi : 13 ♂♂, 1 subad. ♂, 4 ♀♀, 2 unsexed (March 11, 13, May 3-June 16). Markhu Valley : Deorali : 1 unsexed (May 1). Chitlang Valley : Chitlang : 2 ♂♂, 1 ♀ (April 17-26). Nepal Valley : Kathmandu, Godavari, Thankot : 6 ♂♂, 4 ♀♀ (March 30-April 2, 14, 27, May 13, 15, July 24).

We found the white-eye as a common bird of central Nepal from the tarai up to the Nepal Valley. It was abundant in the duns, and occurred in pairs or parties of three to a dozen birds or so in gardens, orchards, forests, on trees overhanging ravines, etc.

Rand & Fleming (1957, p. 198) reported it from western through eastern Nepal.

The birds were approaching breeding condition in March and April, and had fully breeding gonads in May.

The spring moult appears to be rather late or prolonged in this species. A male specimen taken on May 13 still has a few growing feathers on the crown, while another male (May 20) has the central tail feathers in moult.

A subadult male taken on May 18 is moulting into adult plumage.

Colours of soft parts : Iris usually hazel, but grey-brown, brownish buff, yellowish buff, and even creamy white iris was also seen ; bill black with grey on the base of lower mandible (once upper mandible horny with paler horny on base, lower mandible pale bluish slate on basal two-third and dark horny anteriorly) ; legs, and feet bluish slate ; claws horny ; pads white or yellowish white.

Measurements :

	21 ♂♂	12 ♀♀	3 unsexed
Wing :	50, 51, 51.5, 52 (2), 52.5, 53 (10), 54 (2), 54.5, 55 (2)	51 (2), 51.5, 52 (2), 52.5, 53 (2), 53.5, 54, 54.5, 55	51, 54 (2)
Tail :	34, 35, 36 (2), 36.5 (2), 37 (6), 38 (3), 38.5, 39 (3), 41,—	35, 36 (2), 37 (3), 37.5 (2), 38, 39 (2),—	34, 36, 39
Bill :	12, 12.5 (4), 13 (7), 13.5 (5), 14 (3),—	12.5, 13 (8), 13.5, 14 (2)	13 (2), 13.5

In the latest review of the Indian races of the species, Mees (1957, pp. 26-63) has recognized four races in India, namely *palpebrosa* (Nepal, Sikkim, Bengal, probably eastern Bihar, and eastern Orissa, eastward to the greater part of Burma and Yunnan, etc.), *sálimalii* (Eastern Ghats north to Godavari), *nilgiriensis* (Nilgiris, Palnis and associated ranges of south-western India), and *egregia* (Ceylon and the rest of India). While I have not made any special study of the species, I do think that the arrangement proposed by Mees is not entirely satisfactory. For instance, Mees (op. cit., pp. 40, 50) synonymizes *amabilis* Koelz (type locality Sasan, Kathiawar, Gujarat) with *egregia* Madarasz (type locality Ceylon). I do not know if he had the opportunity to examine fresh specimens from Kathiawar, but on comparing recent collections from the Gir Forest (Kathiawar), Balaghat District (Madhya Pradesh), Darjeeling District (West Bengal), etc., I find that the Kathiawar series stands out quite distinctly, so that Koelz's *amabilis* is, in my opinion, a valid race.

It may be further mentioned here that *amabilis* appears to be the most distinct of the Indian races, and the difference between *amabilis* and *egregia* is more than the differences between the four races admitted by Mees, which are nowhere perfectly clear-cut.

Family EMBERIZIDAE

685. **Emberiza pusilla** Pallas. Little Bunting.

BHABAR : Amlekhganj : 1 ♂, 1 ♀, 3 ? subad. ♀♀ (March 6, 8). NEPAL VALLEY : Thankot : 3 ♂♂ (April 3, 9).

The Little Bunting was seen by us only on a few occasions in central Nepal. We observed it in small flocks on hedges and shrubs about cultivation at Amlekhganj (bhabar) and Thankot (Nepal Valley).

Scully (1879), and Ripley (1950b) did not find it in Nepal, but Rand & Fleming (1957, p. 209) recorded it from the Nepal Valley in March, and from the Kamala and Maulung valleys at *c.* 305 and 1830 m. in December.

Two of my male specimens (April 3 and 9) had already attained the summer plumage. Three of my female specimens taken March 6 (listed above as ? subad.) do not appear to be in full adult plumage. They are, moreover, somewhat smaller in size.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	71, 72, 73.5, 74	57, 60 (2), 61	12 (2), 12.5, 13
1 ♀ :	70	57	12
3 ? subad. ♀♀ :	65, 66.5, 67.5	55, 57, 57.5	11.5, 12 (2)

*686. **Emberiza fucata arcuata** Sharpe. Indian Greyheaded Bunting.

Hodgson's later collection (Gray, 1863, p. 57) has furnished the only record of the Greyheaded Bunting for Nepal.

*687. **Emberiza cia stracheyi** Moore. Eastern Meadow Bunting.

The Eastern Meadow Bunting has only recently been recorded for the first time from Nepal by Lowndes (1955, p. 34) who found it in Manangbhot, northern central Nepal, at *c.* 3050-3960 m. during summer. Later, Rand & Fleming (1957, p. 210) have come across it in the Kali Gandak Valley, west-central Nepal, at *c.* 2440-2775 m. in November-December.

Rand & Fleming's specimens represented a variable series from *par* to *stracheyi.*

*688. **Emberiza stewarti** (Blyth). Whitecapped Bunting.

The lone record of the occurrence of the Whitecapped Bunting in Nepal has been furnished by Rand & Fleming (1957, p. 210) from specimens taken in western and west-central Nepal at *c.* 290 and 1370 m. in winter.

*689. **Emberiza spodocephala sordida** Blyth. Blackfaced Bunting.

Hodgson's collection has provided the only record of this bunting from Nepal.

*690. **Emberiza aureola aureola** Pallas. Yellowbreasted Bunting.

The Yellowbreasted Bunting was not observed by us, nor by Ripley (1950b). Scully (1879, p. 334), and Proud (1949, p. 711; 1955, p. 66) found it as a winter visitor to the Nepal Valley; and Rand & Fleming (1957, p. 210) obtained a single specimen from the central duns (Chitawan District) in April.

*691. **Emberiza rutila** Pallas. Chestnut Bunting.

Rand & Fleming's (1957, p. 210) collection of a single example from the Nepal Valley furnishes the sole record of the Chestnut Bunting for Nepal.

692. **Melophus lathami subcristatus** (Sykes). Indian Crested Bunting.

BHABAR : Amlekhganj : 1 ♀ (March 9). DUN : Bhimphedi : 2 ♂♂, 1 ♀ (March 11, 13, May 6). MARKHU VALLEY : Deorali : 1 ♂ (April 30). CHITLANG VALLEY : Chitlang : 1 ♂, 1 ♀ (April 20, 24). NEPAL VALLEY : Thankot : 2 ♂♂, 2 imm. ♂♂, 5 ♀♀, 2 imm. ♀♀ (March 28-April 11).

The Crested Bunting is not uncommonly found in central Nepal. It usually occurs on bushes and shrubs about cultivation.

Ripley (1950b, p. 412), and Rand & Fleming (1957, p. 211) have found it from western to eastern Nepal. Polunin (1955, p. 894) has recorded a single example from the Trisul Valley, central Nepal, at *c.* 1830 m. in summer; and Biswas (1960a) has observed it in the Bhota Kosi Valley, Ramechhāp District, eastern Nepal, at *c.* 1370 m. in February.

One of my male specimens from Bhimphedi, taken on March 11, still has traces of olive-brown edges to black feathers.

A female specimen taken April 11, has the wing coverts in moult.

Measurements :

	6 ♂♂	8 ♀♀
Wing :	81, 82, 82.5, 83 (2), 84	76, 77 (2), 77.5 (2), 78, 78.5, 80
Tail :	66, 68 (3), 69 (2)	64, 65 (2), 66 (2), 67 (2), 69
Bill :	15 (2), 15.5 (2), 16 (2)	14.5, 15 (3), 15.5 (2), 16, —

Family FRINGILLIDAE

693. **Carduelis spinoïdes spinoïdes** Vigors. Himalayan Greenfinch.

Carduelis spinoïdes Vigors, 1831, *Proc. zool. Soc. Lond.* (1) : 44. (Himalayas, restricted to Simla, Himachal Pradesh, by Baker, 1921b, p. 730.)

CHITLANG VALLEY : Chitlang : 1 ♂, 2 ♀♀, 1 imm. ♀ (March 14, April 16, 19). NEPAL VALLEY : Kathmandu, Thankot : 3 ♂♂, 1 (♂), 1 imm. ♂, 5 ♀♀, 1 (♀), 3 imm. ♀♀ (March 20-April 12).

This greenfinch is a common bird of the Chitlang and Nepal valleys. During March-April it occurred in parties consisting of several pairs, sometimes in flocks of about 30-50 individuals, on the edges of forests or on trees about cultivation such as on the suburbs of Kathmandu. During this period the flocks were tending to break up into pairs.

It has been reported from the northern regions of central Nepal by Smythies (1948, p. 442) in the Gandak-Kosi watershed up to *c.* 3655 m. in autumn, Proud (1952a, p. 365) in the same zone but at *c.* 2135 m. in spring, Polunin (1955, p. 893) in the Langtang Valley up to *c.* 3350 m. in summer, and Lowndes (1955, p. 34) in Manangbhot at *c.* 2440-3655 m. in summer. In western and west-central Nepal it has been recorded only by Rand & Fleming (1957, p. 202).

Vaurie (1949c, p. 9) has already reported on the moult of most of my specimens listed above. Some of the immature specimens are beginning to undergo post-juvenile moult; for instance, a male (April 10), two females (March 20 and April 16).

The gonads of the adult birds showed signs of enlargement.

Colours of soft parts : Iris brown to dark brown ; upper mandible brownish fleshy, darker on base and tip ; lower mandible fleshy with dusky tip ; legs and feet brownish fleshy to pale horny ; claws horny ; pads white.

Measurements :

	Wing	Tail	Bill
5 ♂♂ :	76, 79 (2), 80, 81	47, 49, 50 (3)	12.5, 13 (2), 13.5 (2)
8 ♀♀ :	76 (4), 77 (4)	46, 47 (2), 48 (2), 49, 50, —	12.5, 13 (3), 13.5 (3), —

*694. **Carduelis carduelis caniceps** Vigors. Himalayan Goldfinch.

The sole record of the occurrence of the Himalayan Goldfinch in Nepal has been furnished by Lowndes (1955, p. 34) who found it in Manangbhot, central Nepal, between *c.* 3050 and 3960 m. in summer.

Ripley (1961, p. 611) does not include Nepal within the range of this species.

*695. **Carduelis thibetana** (Hume). Tibetan Siskin.

The Tibetan Siskin was not found by us in Nepal, or by Scully (1879) or Ripley (1950b), but Proud (1955, p. 66) observed it in the Nepal Valley late in winter, and Rand & Fleming (1957, p. 202) took specimens there at Godavari in January.

*696. **Leucosticte nemoricola nemoricola** (Hodgson). Hodgson's Mountain Finch.

The first post-Hodgsonian record of this mountain finch from Nepal has been provided by Ripley (1950b, p. 411) who came across it in the Tamur Valley, eastern Nepal, at *c.* 2440-2745 m. in winter. It has subsequently been reported from northern region of central Nepal by Polunin (1955, p. 894) in the Langtang Valley at *c.* 2745-3350 m. in summer, and Lowndes (1955, p. 34) in Manangbhot at *c.* 4265-4725 m. and higher in summer; from eastern Nepal by Rand & Fleming (1957, p. 209) in the Maulung Valley at *c.* 3050 m. in winter, and Biswas (1960a) in the Likhu Valley at *c.* 3655 m. in February and in Khumbu at *c.* 4265-5335 m. in late March-May.

*697. **Leucosticte brandti audreyana** Stresemann. Stresemann's Mountain Finch.

The only record of Stresemann's Mountain Finch from Nepal has been provided by Biswas (1960a) who found it in Khumbu, eastern Nepal, between *c.* 4570 and 4875 m. in February-May.

Nepal has generally been excluded from the range of the species *L. brandti* in standard books, except Ripley's (1961, p. 616) where *L. b. haematopygia* (Gould) is said to extend 'east probably to Nepal'. However, Biswas's specimens are no doubt *audreyana*.

698. **Erythrina erythrina** nr. **erythrina** (Pallas). Russian Rosefinch.

DUN : Bhimphedi: 1 ♂, 1 ♀ (March 14, May 6). CHITLANG VALLEY : Chitlang : 2 ♂♂, 1 imm. ♂ (April 16). NEPAL VALLEY : Kathmandu, Thankot, Chandragiri above Thankot : 8 ♂♂, 5 imm. ♂♂, 7 ♀♀, 3 imm. ♀♀, 1 unsexed (in ♀ plumage) (March 26-April 23).

The Russian Rosefinch is common in central Nepal above *c* 1220 m. during March-April. We found it in small flocks of about half-a-dozen to a dozen birds on bushes and trees, usually about cultivation. On Chandragiri and elsewhere it was found to be particularly fond of the flowers and buds of *Polygonum* sp. on which it was noticed to frequently congregate.

Scully (1879, p. 335) reported it on passage in spring in the Nepal Valley. Ripley (1950b, p. 412) recorded it from western and central Nepal in winter, and Rand & Fleming (1957, p. 203) from western to eastern Nepal in winter, spring and summer.

The immature males are all in feminine plumage. Of them, the one taken on April 4 has a reddish tinge on the chin, and its mantle, wing coverts, and the edges of wings have a slight reddish tone, while another specimen taken on April 10 has only a reddish tinge on the cheeks.

All the specimens had non-breeding gonads.

Colours of soft parts : Iris brown to dark brown ; upper mandible horny or brownish horny with darker horny on culmen ; lower mandible pale horny with darker tip (once much paler, almost white tip) or horny with greyish on base ; legs and feet horny brown ; claws horny ; pads white.

Measurements :

	11 ♂♂	8 ♀♀	1 unsexed
Wing :	81, 82.5, 83 (4), 83.5, 84 (3), 86	80, 81 (2), 82 (2), 83 (2), 86	82
Tail :	56 (2), 57 (3), 58 (2), 59 (2), 60, 61	55, 56, 57 (3), 58, 59 (2)	56
Bill :	14 (6), 14.5 (4), 15	13.5, 14 (4), 14.5 (2), 15	14

Vaurie (1949c, pp. 36-44), Ripley (1950b, pp. 411-412), and Rand & Fleming (1957, p. 203) have commented on the status of the races of the species in India, and I agree that all my winter specimens are 'non-*roseatus*' type, as given by Vaurie (op. cit., p. 44) under '*erythrinus* subspecies'.

*699. **Erythrina erythrina kubanensis** (Laubmann). Caucasian Rosefinch.

Ripley's (1950b, p. 412) single example from western Nepal furnishes the sole record of this Rosefinch from Nepal.

*700. **Erythrina erythrina roseata** (Blyth). Common Indian Rosefinch.

The Common Indian Rosefinch was reported from the Nepal Valley on passage in spring by Proud (1949, p. 710; 1955, p. 66). Ripley (1950b, pp. 411-412) took it in western Nepal in winter. It was further reported from the northern region of central Nepal by Proud (1952a, p. 364) in the Gandak-Kosi watershed at *c.* 2440 m. in spring, Polunin (1955, p. 893) in the Langtang Valley at *c.* 3350 m. in summer, and Lowndes (1955, p. 34) in Manangbhot at *c.* 2745-4265 m. in summer.

*701. **Erythrina rubescens** (Blanford). Blanford's Rosefinch.

The first record of this rosefinch from Nepal is based on Mandelli's collection of a single specimen at Dolakha, Bhota Kosi Valley, Ramechhāp District, eastern Nepal, in August 1875. The only other Nepali report of the species appears to be Polunin's (1955, p. 893) from the Sun Kosi watershed, northern central Nepal, at *c.* 2745 m. in summer.

702. **Erythrina nipalensis nipalensis** (Hodgson). Nepal Dark Rosefinch.

NEPAL VALLEY : Thankot : 1 ♀ (March 21).

The only specimen of the Dark Rosefinch obtained by us was observed in a party of four birds on a tree overlooking a cultivated field at the edge of forest. Very likely, most examples had by then gone to their breeding grounds.

Scully (1879, p. 336) recorded it from the Nepal and Chitlang valleys in winter. Stevens (1925a, p. 371) found it in the Mai Valley, eastern Nepal, at *c.* 2440-2745 m. in April-May. Proud (1949, p. 711) noted it in the Nepal Valley above *c.* 1830 m. in winter. Ripley (1950b, p. 412) came across it in the Nepal Valley and eastern Nepal in winter. Polunin (1955, p. 893) observed it in the Langtang Valley, central Nepal, at *c.* 3050-3350 m. in summer. Rand & Fleming (1957, p. 203) reported it from west-central, central and eastern Nepal between *c.* 1370 and 2285 m. in winter.

Measurements : 1 ♀ : Wing 81 ; tail 53 ; bill 12.

703. **Erythrina rhodochroa** (Vigors). Pinkbrowed Rosefinch.

CHITLANG VALLEY : Chitlang : 1 ♀ (March 15).

Only once a party of about half-a-dozen individuals of the Pinkbrowed Rosefinch was observed by us on scrub at Chitlang. Like the Dark Rosefinch (see above), most of the individuals appeared to have already left for the breeding grounds.

Scully (1879), and Ripley (1950b) did not find it in Nepal. Polunin (1955, p. 893) reported it from the Langtang Valley, central Nepal, at *c.* 3350 m. in summer. Proud (1955, p. 66) observed it on Sheopuri Range bordering the Nepal Valley on the north at *c.* 2440 m. upwards in winter and early spring. Rand & Fleming (1957, p. 204) recorded it from western and west-central Nepal between *c.* 915 and 2745 m. in winter. Biswas (1960a) came across it in Khumbu, eastern Nepal, at *c.* 4265 m. early in May.

Measurements : 1 ♀ : Wing 71 ; tail 55 ; bill 11.5.

*704. **Erythrina rhodopepla** (Vigors). Spottedwinged Rosefinch

The first post-Hodgsonian record of this rosefinch from Nepal appears to be that of Polunin (1955, p. 893) who found it in the Langtang Valley, central Nepal, in summer. It has subsequently been reported also by Rand & Fleming (1957, p. 206) from the Kali Gandak Valley, west-central Nepal, and the Maulung Valley, eastern Nepal, between *c*. 2135 and 3050 m. in winter.

*705. **Erythrina edwardsii rubicunda** Greenway. Nepal Large Rosefinch.

Stevens's (1925a, p. 370) collection of a single example of the Large Rosefinch from the Mai Valley, eastern Nepal, at *c*. 2440 m. late in March, provides the first post-Hodgsonian record of the species from Nepal. Later, Rand & Fleming (1957, p. 206) have also reported a single specimen from western Nepal at *c*. 1065 m. in December.

*706. **Erythrina pulcherrima pulcherrima** (Moore). Beautiful Rosefinch.

Since Hodgson's days, Smythies (1948, p. 442) was the first to report this rosefinch from Nepal. He found it fairly common in the Gandak-Kosi watershed, central Nepal, up to *c*. 3960 m. in autumn. Subsequently, it has been recorded from central Nepal by Polunin (1955, p. 893) in the Langtang Valley at *c*. 3655 m. in summer, and Lowndes (1955, p. 34) in Manangbhot at *c*. 3960-4570 m. in summer. Furthermore, Rand & Fleming (1957, p. 206) found it in the Kali Gandak Valley, west-central Nepal, and the Maulung Valley, eastern Nepal, at *c*. 2135-3050 m. in winter; and Biswas (1960a) noted it as very common in Khumbu, eastern Nepal, between *c*. 3655 and 4570 m. in March-May.

*707. **Erythrina thura thura** (Bonaparte & Schlegel). Nepal White-browed Rosefinch.

The post-Hodgsonian records of the Whitebrowed Rosefinch from Nepal consist of Smythies's (1948, p. 442) observation in the Gandak-Kosi watershed, central Nepal, up to *c*. 4265 m. in autumn; Ripley's (1950b, p. 412) in the Tamur Valley, eastern Nepal, at *c*. 2440 m. in winter; Proud's (1952a, p. 364) in the Gandak-Kosi watershed at *c*. 2560 m. in spring; Polunin's (1955, p. 893) in the Sun Kosi watershed, central Nepal, at *c*. 3960 m. in summer; Rand & Fleming's (1957, p. 204) in the Kali Gandak Valley, west-central Nepal, and the Maulung Valley, eastern Nepal, at *c*. 2745-3050 m. in winter; and Biswas's (1960a) in Khumbu, eastern Nepal, at *c*. 4265 m. early in May.

*708. **Erythrina rubicilloides lucifer** (R. & A. Meinertzhagen). Tibetan Great Rosefinch.

The only record of the Tibetan Great Rosefinch from Nepal has been furnished by Rand & Fleming (1957, p. 205) who found it in the

Kali Gandak Valley, west-central Nepal, at *c.* 2775 and 2805 m. in winter.

*709. **Erythrina punicea punicea** (Blyth). Nepal Redbreasted Rosefinch.

The first post-Hodgsonian record of the redbreasted rosefinch from Nepal is based on Smythies's (1948, p. 442) observation in the Gandak-Kosi watershed, central Nepal, at *c.* 3655 m. in autumn. It has subsequently been reported by Lowndes (1955, p. 34) from Manangbhot, central Nepal, at *c.* 4265-4420 m. in summer; Rand & Fleming (1957, p. 205) from the Kali Gandak Valley, west-central Nepal, at *c.* 2745 m. in winter; and Biswas (1960a) from Khumbu, eastern Nepal, at *c.* 4875 m. in mid-May.

*710. **Propyrrhula subhimachala** (Hodgson). Redheaded Rosefinch.

Since Hodgson's days, the Redheaded Rosefinch has been recorded from Nepal by Smythies (1948, p. 442) in the Gandak-Kosi watershed, central Nepal, at *c.* 3350 m. in autumn; Ripley (1950b, p. 412) in the Tamur Valley, eastern Nepal, at *c.* 2745 m. in winter; Polunin (1955, p. 893) in the Langtang Valley, central Nepal, at *c.* 3960 m. in summer; and Rand & Fleming (1957, p. 209) in the Maulung Valley, eastern Nepal, at *c.* 3050 m. in winter.

Vaurie (1956a, pp. 36-37) has discussed the question of geographical variation in this species.

*711. **Loxia curvirostra himalayensis** Blyth. Himalayan Crossbill.

The only two post-Hodgsonian records of the Crossbill from Nepal are Stevens's (1925a, p. 368) in the Singalila Range, eastern Nepal, at *c.* 3505 m. in March, and Rand & Fleming's (1957, p. 209) in the Maulung Valley, eastern Nepal, at *c.* 3050 m. in winter.

712. **Pyrrhoplectes epauletta** (Hodgson). Goldheaded Blackfinch.

NEPAL VALLEY: Thankot: 6 ♂♂, 3 imm. ♂♂, 3 ♀♀, 1 imm. ♀ (March 18-April 12).

The Goldheaded Blackfinch is not uncommon in small parties of three to six birds on bushes and trees in the forests around Thankot during March and April.

The only other post-Hodgsonian record of this species from Nepal appears to be that of Stevens's (1925a, p. 368) from the Mai Valley, eastern Nepal, at *c.* 1830 m. in April.

The immature birds (♂♂: March 21, April 1, 5; ♀: March 25) are all moulting into adult.

Measurements :

	Wing	Tail	Bill
6 ♂♂ :	75+, 78, 79(2), 80(2)	54+, 58, 59, 60, 61(2)	12.5(4), 13(2)
3 ♀♀ :	74, 75, 77	53, 56(2)	12(3)

713. **Haematospiza sipahi** (Hodgson). Scarlet Finch.

DUN : Bhimphedi : 3 ♀♀ (May 6).

We did not find the Scarlet Finch at all common in central Nepal. Once a party of eight birds was observed in the pine forest off Bhimphedi when the three specimens listed above were taken. Ours appears to be the only post-Hodgsonian record of the species from Nepal.

Measurements : 3 ♀♀ : Wing 99, 101, 102 ; tail 63(2), 67 ; bill from anterior edge of nostril 12(3).

*714. **Pyrrhula erythrocephala** Vigors. Redheaded Bullfinch.

Ripley (1950b, p. 412) has provided the first post-Hodgsonian record of the Redheaded Bullfinch from Nepal. He came across it in the Tamur Valley, eastern Nepal, at *c.* 2440 m. in winter. It has also been found by Proud (1952a, p. 364) in the Gandak-Kosi watershed, central Nepal, at *c.* 2440-2745 m. in spring; Polunin (1955, p. 893) in the Langtang Valley, central Nepal, at *c.* 3655-3960 m. in summer; Lowndes (1955, p. 34) in Manangbhot, central Nepal, at *c.* 3655-3960 m. in July-August; Proud (1955, p. 66) on Sheopuri Range, Nepal Valley, at *c.* 2440 m. in April-May; Rand & Fleming (1957, pp. 206-207) in the Kali Gandak Valley, west-central Nepal, and in the Maulung Valley, eastern Nepal, at *c.* 2135-3960 m. in December; and Biswas (1960a) in Khumbu, eastern Nepal, at *c.* 3655-4265 m. in March-May.

715. **Pyrrhula nipalensis nipalensis** Hodgson. Nepal Brown Bullfinch.

CHITLANG VALLEY : Chitlang: 3 ♂♂ (April 17). NEPAL VALLEY : Thankot : 1 ♂ (March 24).

The Brown Bullfinch did not appear to us to be particularly common in central Nepal during March-April. We came across it on a few occasions in small flocks of about six to a dozen birds on bushes and trees in the forests on Chandragiri at *c.* 1525 m. upwards above both Thankot and Chitlang.

Scully (1879, p. 335) found it only once in the Nepal Valley in February. Smythies (1948, p. 441; 1950, p. 516) noted it on Sheopuri Range, Nepal Valley, and further northward in the Gandak-Kosi watershed at *c.* 2135-2440 m. in autumn. Proud (1955, p. 66) observed it on Sheopuri Range and Phulchauki Danda in the Nepal Valley from winter until May. Rand & Fleming (1957, p. 207) also found it in the Nepal Valley on Phulchauki Danda and its base at Godavari in March and May.

Measurements: 4 ♂♂ : Wing 85, 87, 88.5, 89 ; tail 71, 74, 75, 79 ; bill 14(2), 14.5, —.

*716. **Mycerobas affinis** (Blyth). Allied Grosbeak.

The only post-Hodgsonian records of the Allied Grosbeak from Nepal appear to be Stevens's (1925a, p. 366) from the Singalila Range, eastern Nepal, at *c.* 2895 m. on January 31, and Lowndes's (1955, p. 33) from Manangbhot, central Nepal, at *c.* 3810 m. in August.

*717. **Mycerobas carnipes carnipes** (Hodgson). Whitewinged Grosbeak.

Since Hodgson's days the Whitewinged Grosbeak has been reported from Nepal several times. Thus, in west-central Nepal, it has been found by Rand & Fleming (1957, p. 207) in the Kali Gandak Valley at *c.* 2745 m. in December; in the northern region of central Nepal in the Gandak-Kosi watershed by Smythies (1948, p. 441) at *c.* 3655 m. in autumn, and Proud (1952a, p. 364) at *c.* 3200-3655 m. in spring, and in Manangbhot by Lowndes (1955, p. 34) at *c.* 3050-4265 m. in summer; in eastern Nepal by Biswas (1960a) from Khumbu at *c.* 3655-4265 m. in February-April.

718. **Mycerobas melanozanthos** (Hodgson). Spottedwinged Grosbeak.

CHITLANG VALLEY : Chitlang : 1 ♀ (April 21).

The Spottedwinged Grosbeak appeared to be decidedly a rare bird in central Nepal. We saw it only once in a small flock of perhaps eight birds on a tree near Chitlang.

Scully (1879), and Ripley (1950b) did not find it in Nepal, but Rand & Fleming (1957, pp. 208-209) recorded a single example from the Nepal Valley in February.

My specimen was just finishing a complete (prenuptial) moult.

Measurements: 1 ♀ : Wing 129 ; tail 72 ; bill 24.

Vaurie (1956b, p. 22) has discussed the geographical variation in this species.

(*To be continued*)

Studies on the Freshwater Oligochaeta of South India

I. Aeolosomatidae and Naididae

PART 5

BY

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(*With eight text-figures*)

[*Continued from Vol.* **59** (3) : 921]

c. Subfamily STEPHENSONIANINAE nov.

Type genus : *Stephensoniana* Černosvitov

Prostomium simple. No eyes. Dorsal setae begin in II, consist of hairs and needles. Ventral setae of 2 types. Pharynx with dorsal diverticulum. Coelomocytes absent. Nephridia present. Testes and spermathecae in IV ; ovaries and atria in V. Four segments formed anteriorly by budding.

9. Genus **Stephensoniana** Černosvitov, 1938

Generic characters : Prostomium triangular. Dorsal bundles from II with hairs and simple-pointed anodulate needles. Ventral setae of II-V distinct from the rest. Stomach absent. Septa present, no septal glands. Dorsal vessel lateral mostly, mid-dorsal anteriorly. Budding zone single.

28. **Stephensoniana trivandrana** (Aiyer, 1926)

Fig. 28 A-D

Stephensoniana trivandrana (Aiyer). Sperber, 1948, pp. 208-209, fig. 28c.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in May and December 1955 ; from the Brucepettah tank, Bellary, in April 1954.

Worms small, filiform, reddish brown, tapering abruptly from VI anteriorly, gradually from middle to posterior end. Prostomium bluntly triangular. Eyes absent. Anterior $\frac{1}{2}$-$\frac{2}{3}$ covered by mucus sheath to which fine sand particles and clay adhere around annuli and give papillated appearance ; posterior $\frac{1}{2}$-$\frac{1}{3}$ delicate without sheath, probably for respiration.

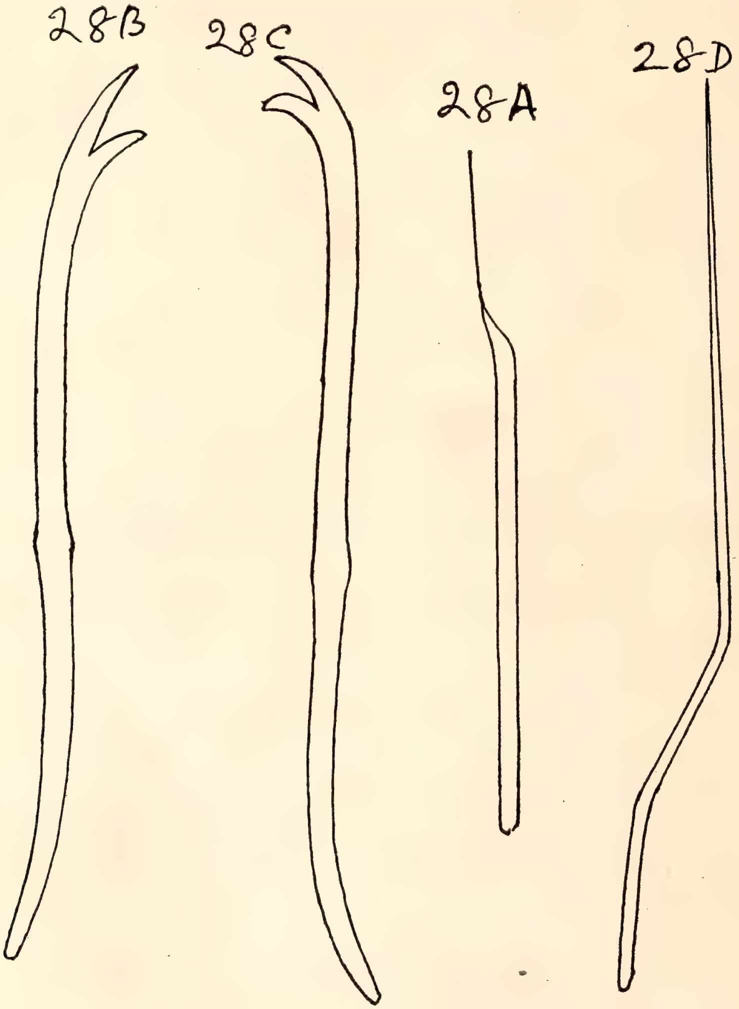

Fig. 28. *Stephensoniana trivandrana* (Aiyer): A. Needle seta × 1450 ; B. Ventral seta of II × 1450 ; C. Ventral seta of V × 1450 ; D. Hair seta × 1000.

Dorsal setae start in II, 3-5 hairs and 3-5 needles in couples of 1 hair and 1 needle per bundle. Hair (Fig. 28 D) clearly bayonet-shaped, 115-175 μ long. Needle (Fig. 28 A) simple, straight, suddenly tapering and slightly curved near the tip, without nodulus, 42-52·5 μ long. Ventral setae (Fig. 28 B, C) 4 per bundle anteriorly, decreasing to 1 posteriorly ; in II-IV straight with proximal nodulus (D : P :: 14 :12), 77-93 μ

long, less curved, distal prong thicker and longer than proximal; in rest 76-91 μ long with distal nodulus (D : P :: 16 : 10), distal prong twice as long and as thick as proximal and prongs end in sharp points.

Pharynx in II-III, wide with dorsal diverticulum protrusible through mouth for feeding. Oesophagus in IV-V, thin and sinuous. Stomach absent. Intestine starts in VI and wide all through. Chloragogues cover the gut from VI, and brown. Intestinal antiperistalsis and ascending ciliary vibration occur. Septa well developed; no septal glands. Coelomocytes absent. Intestinal wall posteriorly has orange-red pigment.

Blood orange-red. Dorsal vessel ventrally attached to gut on the left from hind end to V, where it takes a spiral course and runs mid-dorsally in anterior segments. Contractile vascular vessels 1 pair in V, connect dorsal and ventral vessels.

First nephridium in VI with its pre-septal funnel in V; post-septal has a fusiform ampulla and a long coiled duct ending in nephridiopore ventrally.

One budding zone developed at a time; some hind segments for anterior zooid are budded off earlier than prostomium and four anterior segments of posterior zooid, before fission.

Sexual worms not encountered.

1 (p.) = 2 mm.; d (p.) = 0.2 mm.; s = 32 + undifferentiated zone; n = 12-14.

Lengths of longest setae in μ and position of nodulus in ratio D : P : :

	II	III	IV	V
Hair	126	157	175	175
Needle	42	52.5	52.5	52.5
V. seta	92.7	91	77	91
	14:12.5	14:12	12:10	16:10

Distribution in Indian sub-continent : Trivandrum in Travancore (S. India). Now recorded from Cuddapah and Bellary (S. India).

Remarks : The worms move very slowly on muddy substratum and wriggle briskly in water. When disturbed or taken into pipette they coil into flat and close spirals like *Aulophorus michaelseni* and *Pristina synclites*. Stomach absent. Gut abruptly widens in VI and continues so throughout.

Parasites : Large number of holotrichus astomatous ciliate parasites have been found in the gut of several worms. These parasites emerge out of their bodies through the mouth when slight pressure is exerted on them with cover glass on slides.

Habits : Swim by brisk wriggling movement.

Subfamily PRISTININAE Lastočkin, 1924

10. Genus **Pristina** Ehrenberg, 1828

Generic characters : No eyes. Prostomium with or without proboscis. Dorsal setae from II or III or IV, hairs and needles ; ventral setae all of one type. Pharyngeal glands present ; stomach fusiform or pear-shaped, usually with intracellular canals. Intestinal anti-peristalsis and ascending ciliary vibration occur. Septa well developed; septal glands present. Coelomocytes present. Dorsal vessel median (lateral in *P. synclites*). Nephridia start in IX, with pre-septal and post-septal in two successive segments. Budding zones 1-3, produce prostomium and seven anterior segments to the posterior zooid and some hind segments to the anterior zooid before fission.

KEY TO ALL THE KNOWN AND VALID SPECIES AND SUBSPECIES OF *PRISTINA*

- A-1 Needles simple-pointed
  - B-1 Prostomium with proboscis ; needles fine, straight
    - C-1 Dorsal setae beginning in II
      - D-1 Hairs of III specially elongated
        - E-1 Distal tooth of ventral setae of II and III nearly twice as long as proximal .. *longiseta longiseta*
        - E-2 Distal tooth of ventral setae of II and III thrice as long as proximal
          - F-1 Ventral setae of III fewer than in following segments ; serrations of hair close and fine .. **longiseta sinensis*
          - F-2 Ventral setae of III not fewer than in following segments ; teeth of serrations of hair far apart .. **longiseta leidyi*
      - D-2 Hairs of II-VII shorter, in others specially elongated .. **biserrata*
      - D-3 Hairs not specially elongated in any segment *proboscidea*
    - C-2 Dorsal setae beginning in III or IV .. **macrochaeta*
  - B-2 Prostomium without proboscis ; needles bayonet-shaped .. *menoni*
- A-2 Needles double-pointed
  - G-1 Prostomium with proboscis
    - H-1 Hairs specially elongated in one or more segments
      - I-1 Hairs of III specially elongated .. **longiseta bidentata*
      - I-2 Hairs of IV-VI specially elongated .. **schniederi*
    - H-2 No specially elongated hair in any segment
      - J-1 Needle teeth fine
        - K-1 Giant ventral setae present
          - L-1 Giant ventral setae in IV, bifid .. *aequiseta*
          - L-2 Giant ventral setae in V, single pointed .. *evelinae*

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* Species not known from the Indian sub-continent.

K-2 Giant ventral setae absent

M-1 Dorsal bundles with not more than 4 hairs and 4 needles; ventral setae of III not shortest; length of worms up to 6.5 mm. .. _foreli_

M-2 Dorsal bundles with 1 hair and 1 needle; ventral setae of III shortest; length of worms up to 2 mm. .. _sperberae_ sp. nov.

J-2 Needle teeth long and unequal

N-1 Distal tooth of needles longer than proximal .. _*plumaseta_

N-2 Distal tooth of needles shorter than proximal

O-1 Distal tooth of needle slightly shorter than proximal; hairs non-serrate .. _synclites_

O-2 Distal tooth of needle about half as long as the proximal; hairs serrate .. _*americana_

J-3 Needle teeth long and equal

P-1 Needle teeth diverging; dorsal bundles with 1 hair and 1 needle; hair non-serrate; stomach in VII .. _breviseta_

P-2 Needle teeth parallel; dorsal bundles with 2-4 hairs and 1-3 needles; hairs closely serrate; stomach in VIII .. _*peruviana_

G-2 Prostomium without proboscis

Q-1 Needle teeth short and about equal

R-1 Dorsal setae stout in III; hairs of III-IV specially elongated up to 1200 μ long .. _*bilongata_

R-2 Dorsal setae start in II; hairs not specially elongated in any segment

S-1 Intermediate teeth 2-3 between main teeth in needles .. _*sima_

S-2 No intermediate teeth between main needle teeth

T-1 Needle teeth parallel; hairs serrate _*bilobata_

T-2 Needle teeth diverging with wide angle; hair non-serrate .. _minuta_

T-3 Needle teeth diverging at acute angle; hairs serrate .. _*notopora_

Q-2 Needle teeth long, distal tooth shorter than proximal

U-1 Distal tooth of needles much shorter than proximal, teeth diverging; hair non-serrate; needles thicker in IV (and V) than in others _*amphibiotica_

U-2 Distal tooth of needles shorter than proximal

V-1 Needle teeth parallel and long, distal slightly shorter than proximal; needles in IV longer and stouter than in others; hairs non-serrate .. _*idrensis_

*** Species not known from the Indian sub-continent.**

V-2 Needle teeth diverging ; distal tooth about half as long as proximal
  W-1 Proximal tooth of needles 5-10 μ long; hairs non-serrate ; nodulus median in anterior ventral setae and distal in others .. *jenkinae*
  W-2 Proximal tooth of needles 3-5 μ long ; hairs finely serrated ; all ventral setae with slightly distal nodulus .. **rosea*

29. **Pristina minuta** (Stephenson, 1914)

Fig. 29 A-C

Naidium minutum Stephenson. Stephenson, 1915 a, p. 786.
Pristina minuta (Stephenson). Sperber, 1948, pp. 222-223.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in December 1955 and January 1956.

Worms pale white, minute, slender. Prostomium bluntly triangular without proboscis. Anterior 7 segments shorter than succeeding segments in all adult worms. Anus in a notch bounded by 2 lobes on either side.

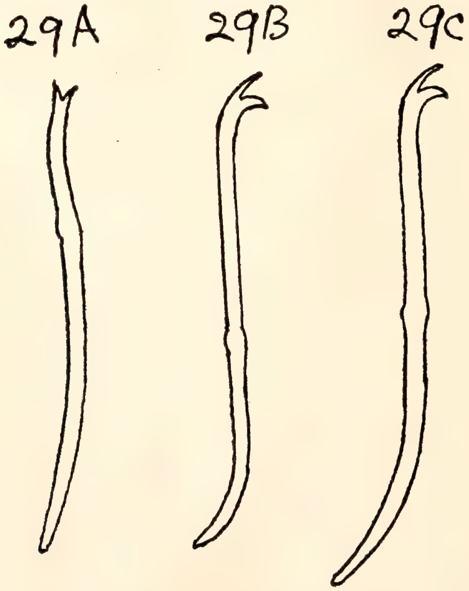

Fig. 29. *Pristina minuta* (Stephenson) : A. Needle seta × 2000 ; B. Ventral seta of II × 2000 ; C. Ventral seta of a middle segment × 2000.

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*Species not known from the Indian sub-continent.

Dorsal setae start in II, each bundle with 1 hair and 1 needle. Hairs non-serrate, straight, 91-112 μ long. Needles (Fig. 29A) bifid, 24.5-35 μ long, with distal nodulus (D : P : : 3 : 7), teeth of equal length and diverging. Ventral setae (Fig. 29 B, C) 3-5 per bundle, decreasing to 2-3 posteriorly, 31.5-36.5 μ long, shortest in II gradually increasing in succeeding segments, nodulus median (D : P : : 5 : 4 or 5.5 : 5.5), prongs of equal thickness, distal longer than proximal.

Pharynx in II-IV ; oesophagus in V-VII ; stomach in VIII, abrupt and pear-shaped ; intestine thin and flexed on itself in IX and wide from X. Chloragogues begin in VIII, yellowish brown. Coelomocytes granular, morula-like, grey, largest 14 μ in diameter. Septal glands on 4/5, 5/6 and 6/7.

Blood tinged with light shade of red. Dorsal vessel contractile and mid-dorsal.

Nephridia in IX-XII or XIII, 1 per segment. Each nephridium has nephrostome-bearing pre-septal funnel in one segment and post-septal with a long coiled duct and nephridiopore in next segment.

Only one budding zone develops at a time in a worm.

Sexual worms not encountered.

l (living) = 1.5-1.85 mm. ; d (living) = 0.13 mm. ; s = 16 ; n = 12.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X	XI
Hair	91	94	101.5	108.5	112	108.5	87.5	87.5	91	—
Needle	26.3	28	31.5	33.3	35	35	35	35	35	35
	3:4.5	3:5	3:6	3:6.5	3:7	3:7	3:7	3:7	3:7	3:7
V. seta	31.5	35	35	36.5	36.5	38.5	38.5	38.5	35	36.7
	5:4	5:5	5:5	5.5:5	5:5.5	5.5:5.5	5.5:5.5	5.5:5.5	5:5	5:5.5

Distribution in Indian sub-continent : Lahore (Pakistan). Now recorded from Cuddapah (S. India).

Habits : No swimming. Backward progression present.

Remarks : These worms have longer needle teeth than the worms of Stephenson. Length of setae, body length, and segment number of the present worms agree with those given by Stephenson (1914), and Marcus (1943).

Naidium osborni Walton (1906, Galloway 1911, Smith 1918) with l = 1.6 mm., s = 15-16, stomach in VIII, agrees very well with *Pristina minuta* (Stephenson). It, however, differs greatly from the latter in having very much longer needles and hairs (needles 50 μ as against 35 μ and hairs 140 μ as against 120 μ). If they are identical, *N. osborni* (with similar body length as *Pr. minuta*) ought to have had setae of similar length. With very much longer setae (particularly needles) for such a small specimen, as Marcus (1943) suggested, it is not identical with *Pr. minuta*, but a distinct species *Pr. osborni* (Walton).

30. **Pristina synclites** Stephenson, 1925

Fig. 30 A-D

Pristina synclites Stephenson. Sperber, 1948, p. 225.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in March 1954, May 1955 ; from the Kandakam tank, Bellary, in April 1954 ; from Miller's tank and Langford Town tank, Bangalore, in May 1958.

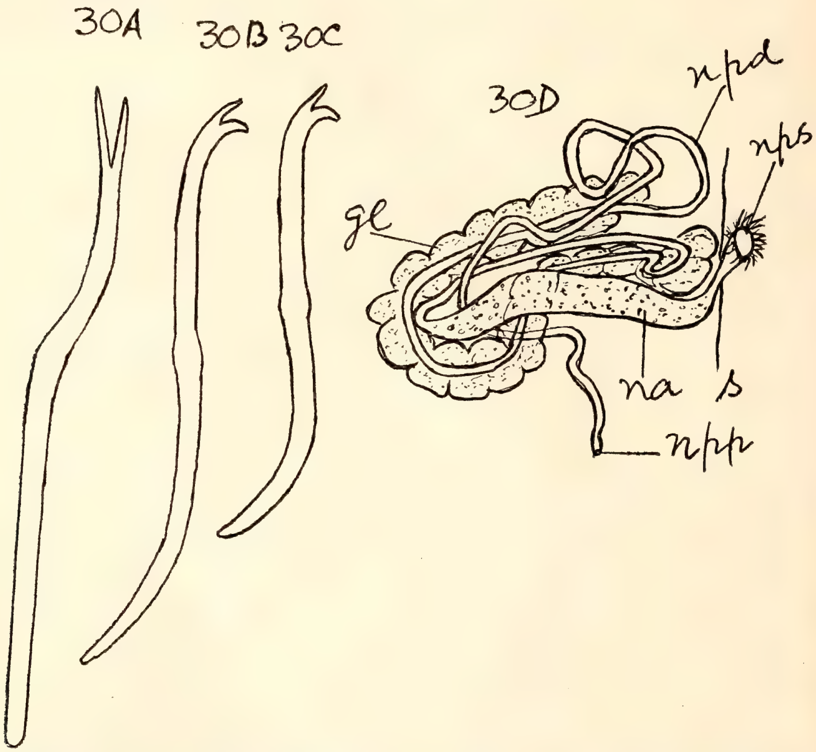

Fig. 30. *Pristina synclites* Stephenson : A. Needle seta × 1400 ; B. Ventral seta of II × 1400 ; C. Ventral seta of a posterior segment × 1000 ; D. Nephridium.
gl : gland ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridiopore ; *nps* : nephrostome ; *s* : septum.

Worms largest among the 7 species of *Pristina* in the locality, light red in colour. Posterior half of body is slender, highly vascularised, decreasing gradually in diameter to blunt hind end. Prostomium with a delicate proboscis, with sensory hairs, frequently breaking off partly or wholly. Proboscis shorter than the triangular prostomium.

Dorsal setae start in II, each bundle with 1-2 hairs and 1-2 needles. Hairs slightly bayonet-shaped, non-serrate 175-350 μ long, shorter than body-diameter. Needles (Fig. 30A) bifid, bayonet-shaped 70-101.5 μ long, with weak, distal nodulus (D : P : : 9 : 17), teeth faintly diverging, proximal slightly longer and thicker than distal. Ventral setae (Fig. 30 B, C) 4 per bundle, decreasing to 2 posteriorly, 63-87.5 μ long, length increasing from II-V and gradually decreasing from VI onwards. Nodulus median in II-IV and distal from V on. Prongs equally long, distal thinner than proximal.

Pharynx in II-½IV, wide. Oesophagus in ½IV-VI, thin and straight. Stomach in VII-VIII, gradual and fusiform without intracellular canals. Intestine thin and wavy in IX-XI, wide and sacculated behind, opening at hind end in a notch. Chloragogues cover from VI on, brownish and cover also dorsal vessel. Septal glands in IV-V. Coelomocytes grey, granular, spherical and largest measure 17.5μ in diameter.

Brain incised deeply in front and less deeply behind.

Blood orange-red. Dorsal vessel contractile, laterally attached to left of gut up to XII, unattached in IX-VIII, again attached in VII-VI, and mid-dorsal in anterior 5 segments. Contractile lateral vessels, 4 pairs, first 2 pairs in the middle of IV and V, other 2 pairs nearer posterior septa of VI and VII. Non-contractile loops in II-III. Dorsal vessel thicker in slender hind part of body and gives off several non-contractile vessels to body-wall, 1 pair per segment. Vascular plexus exists anteriorly.

First nephridium (Fig. 30 D) in IX with its short pre-septal funnel in VIII; post-septal with a long cylindrical granular ampulla followed by a coiled duct, partly passing through gland tissue and opening by nephridiopore.

Single budding zone common, 2 zones rare; buds off hind part of anterior zooid and proboscid prostomium and 7 anterior segments to posterior zooid before they separate. In fact it is only after the production of hind part to anterior zooid budding of anterior segments to posterior zooid takes place.

1 (p.) = 4-4.5 mm.; d (p.) = 0.35 mm.; s = 42-63; n = 18-23.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

Cuddapah worm

	II	III	IV	V	VI	VII	VIII	IX	X	XI
Hair	126	182	238	241.5	245	255.5	259	259	266	227.5
Needle	52.5	61.5	75.2	80.5	80.5	80.5	80.5	80.5	80.5	77
	5:10	6:9.5	8:13.5	10:13	10:13	10:13	10:13	10:13	10:13	9:13
V. seta	63	63	77	70	73.5	73.5	73.5	73.5	73.5	73.5
	9:9	9:9	10:12	9:11	10:11	10:11	10:11	10:11	10:11	10:11

Bellary worm

	II	III	IV	V	VI	VII	VIII	IX	X	XI
Hair	175	227.5	266	350	315	371	280	201	301	301
Needle	70	73.5	89.3	94.5	91	98	101.5	87.5	87.5	87.5
	7:13	7:14	6.5:17	9:18	9:17	9:19	9:20	9:16	9:16	9:16
V. seta	63	66.5	73.5	80.5	84	77	77	73.5	71.7	73.5
	9:9	9.5:9.5	10:11	10:13	10:14	10:12	9:13	9:12	9:11.5	9:12

Distribution in Indian sub-continent: Recorded only from Mysore (S. India). Now recorded from Cuddapah, Bellary, and Bangalore (S. India).

Habits: Worms coil into flat spirals when disturbed. They live in soft mud along with *Dero dorsalis, Aulophorus michaelseni, Limnodrilus socialis,* etc. Swimming absent.

Remarks : Needles and ventral setae of these specimens are longer than in the specimens of Stephenson (1925b). As reported by Stephenson the hind half of the body has numerous vascular loops similar to those seen in the tubificids. During budding the hind segments of the anterior zooid are budded off before the anterior segments of the posterior zooid start forming.

31. **Pristina jenkinae** (Stephenson, 1931)

Fig. 31 A-B

Pristina jenkinae (Stephenson). Sperber 1948, pp. 224-225 ; 1958, p. 51, fig. 17.

Pristina rosea (Piguet). Yamaguchi, 1953, p. 286.

Material examined: One worm collected from the Kandakam tank, Bellary, in May 1954.

Worm small and pale white. Prostomium bluntly triangular without proboscis.

Dorsal setae begin in II, each bundle with 1-2 hairs and 1-2 needles. Hairs nearly straight, non-serrate, 108-210 μ long, about equal to body-diameter, in II nearly half, in III $\frac{3}{4}$ as long as, in following segments. Needles (Fig. 31 A) bifid, bayonet-shaped, nodulus distal (D : P : : 6 : 11), 53-65.5 μ long, teeth faintly diverging, unequal and blunt, proximal tooth twice as long and as thick as distal. Ventral setae (Fig. 31 B) all of one type, 4-5 per bundle, decreasing to 2-3 posteriorly, nodulus median (D : P : : 6 : 6.5 or 6 : 7) in anterior segments, and slightly distal (D : P : : 6 : 8) in rest ; shortest setae in II-III, 43.7-45.5 μ long, abruptly increasing to 52.5 μ in IV and decreasing in middle and hind segments ; with teeth about equally long, distal thinner than proximal.

Pharynx in II-IV, wide. Oesophagus in V-VI, thin and sinuous. Stomach in VII-$\frac{1}{2}$VIII, gradual and fusiform. Intestine thin in IX, wide from X on, opening by anus in a notch at hind end. Septa delicate and complete. Coelomocytes spherical, granular, largest 12 μ in diameter. Chloragogues cover gut from VI, brownish.

Blood yellowish red. Dorsal vessel attached laterally to left from hind end to VI, mid-dorsal in anterior 5 segments. Simple vascular vessels 6 pairs in II-VII, latter 4 pairs contractile.

First nephridium in IX with its nephrostome in VIII, post-septal coiled duct opens by nephridiopore ventro-laterally.

Budding occurs as seen in a single worm. As the worm was in early stage of budding, the number of segments budded off to posterior zooid cannot be stated. The presence of first nephridium in IX as in other species of the genus, indicates that 7 anterior segments are budded off here also.

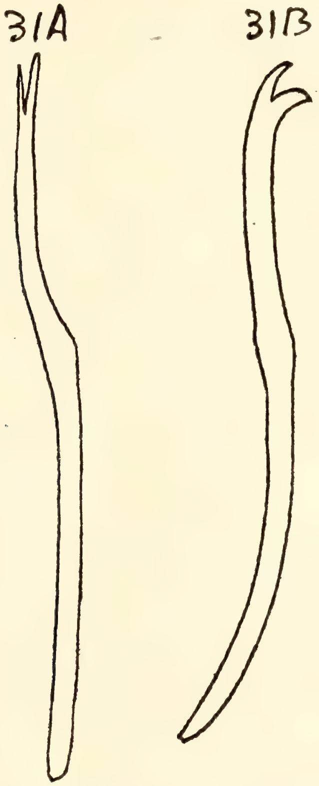

Fig. 31. *Pristina jenkinae* (Stephenson): A. Needle seta × 1600; B. Ventral seta × 2000.

Sexual worm not encountered.

l (living) = 25 mm.; d (living) = 0.17 mm.; s = 22 + undifferentiated region; n = 16 (in one).

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	108.5	150.5	178.5	210	175	175	175	168	157.5
Needle	38.5	52.5	64.7	66.5	59.5	59.5	59.5	59.5	59.5
	4:7	6:9	6.5:12	7:12	6:11	6:11	6:11	6:11	6:11
V. seta	43.7	45.5	52.5	52.5	52.5	52.5	52.5	49	49
	6.5:6	6:7	7:8	7:8	7:8	7:8	7:8	6:8	6:8

Distribution in Indian sub-continent : Now recorded from Bellary (S. India); first record for the Indian sub-continent.

Habits : Swimming absent.

Remarks : The description given here is from a single non-sexual worm. The lengths of setae of the present worm agree very closely with those of Stephenson (1931a).

Sperber (1948) is undoubtedly right in pointing out that *Naidium roseum* Piguet of Marcus (1943) is identical with *Pristina jenkinae* (Stephenson). It agrees very closely with the present species in all respects.

Pristina rosea (Piguet) of Kondô (1936) certainly belongs here, as pointed out by Sperber, as its needles (Pl. 24, fig. 16a) are stated to resemble those of *Pr. jenkinae*, and its chalk-white colour agrees with that of latter, not with rose-coloured *Pr. rosea*. *Pr. rosea* (Piguet) of Michaelsen & Boldt (1932) may also belong here.

32. **Pristina aequiseta** Bourne, 1891

Fig. 32 A-D

Pristina aequiseta Bourne. Lastočkin, 1927. p. 67 ; Černosvitov, 1938, pp. 536, 538 ; Berg, 1948, p. 50 ; Sperber, 1948, pp. 230-232, fig. 24, pl. XXI fig. 5 ; 1950, p. 77, fig. 28b, pl. III fig. 8 ; Causey, 1953a, p. 55 ; 1953b, pp. 422-423; Yamaguchi, 1953, pp. 284-285, fig. 4.

Material examined : Numerous worms collected from the Bugga stream, Cuddapah, in February 1954; from the Balaji tank, Kakinada, in November 1956 ; from the Kandakam tank, Bellary, in April 1954.

Worms small and whitish. Prostomium with fairly long, mobile proboscis with sensory hairs. Anus in a notch bounded by rounded lobes on either side.

Dorsal bundles start in II, each bundle with 1-2 hairs and 1-2 needles. Hairs finely serrated, straight, 100-240 μ long, not specially elongated in III, increase in length from II-IV. Needles (Fig. 32 A) bifid, bayonet-shaped, 31-45 μ long, without nodulus and with fine teeth. Ventral setae (Fig. 32 B, C) 5-6 per bundle, in II, 52-56 μ long, thicker and longer than the rest, with nodulus slightly proximal (D : P : : 9 : 7), distal prong 1.5 times as long as proximal ; in III 43-45.5 μ long with slightly distal nodulus (D : P : : 6 : 7), distal prong slightly longer than proximal ; in IV giant setae 1-2 per bundle (Fig. 32 D), longest of all 66.5-70 μ long and peculiarly shaped, with distal prong strongly hooked and thicker than the rudimentary proximal prong and distal nodulus (D : P : : 8 : 11) ; in the rest 45-51 μ long, prongs of about equal length and thickness ; with slightly distal nodulus (D : P : : 6 : 7).

Pharynx in II-IV, wide with inner wall ciliated and roof eversible. Oesophagus in V-VII, thin and sinuous. Stomach in VIII, abrupt and pear-shaped with intracellular canals. Intestine thin and wavy in IX and wide from X. Chloragogues start in VI and greenish brown. Septal glands in III-V. Coelomocytes spherical, morula-like with grey granules, largest of 14 μ diameter.

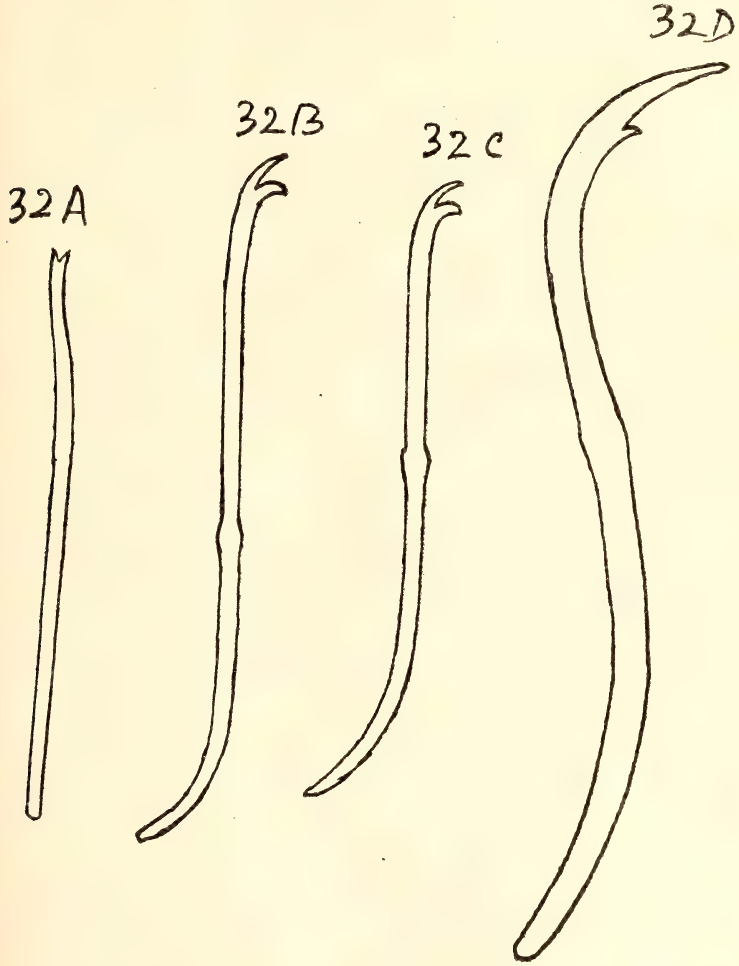

Fig. 32. *Pristina aequiseta* Bourne : A. Needle seta × 2000 ; B. Ventral seta of II × 2000 ; C. Ventral seta of IX × 2000 ; D. Giant ventral seta of V × 2000.

Brain incised anteriorly and posteriorly.

Blood tinged with yellow. Dorsal vessel contractile and mid-dorsal. Contractile vascular vessels 6 pairs in II-VII connecting dorsal and ventral vessels.

First pair of nephridia in IX with pre-septal nephrostome in VIII.

Single budding zone common, two zones rare, second zone always developing in anterior zooid a segment in front of the first zone.

l (p.) = 1-1.5 mm. (single), 1.5-2 mm. (chain) ; d (p.) = 0.2 mm.; s = 17-20 ; n = 12-18.

Lengths of longest setae in μ and position of nodulus in the ratio D : P ::

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	105	140	161	189	192.5	192.5	210	210	210
Needle	31.5	35	42	42	42	43.7	43.7	43.7	43.7
V. seta	56	45.5	66.5	49	49	49	45.5	45.5	45.5
	9:7	6:7	8:11	6:8	6:8	6:8	6:7	6:7	6:7

Distribution in Indian sub-continent : Calcutta, Allahabad (N. India). Now recorded from Cuddapah and Bellary (S. India).

Remarks : Setae of the present specimens agree in form with those in literature, and are slightly longer than those recorded by Piguet (1906) and Marcus (1943), and agree with those tabulated for a single Swedish specimen (Sperber, 1948, p. 231).

Pristina aequiseta var. ? from S. America (Michaelsen, 1913) and *Pr. aequiseta* Bourne from Germany (Hempelmann, 1923) and from south India (Aiyer, 1930) with giant ventral setae having a single hooked prong in V have been included in this species by Sperber (1948). These forms are actually *Pristina evelinae* Marcus, 1943.

33. **Pristina evelinae** Marcus, 1943

Fig. 33 A-D

Pristina aequiseta Bourne var.? Michaelsen, 1913, pp. 209-211.

Pristina aequiseta Bourne. Hempelmann, 1923, pp. 380-444 ; Aiyer, 1930, pp. 25-26, fig. 5.

Pristina evelinae Marcus. Sperber, 1948, p. 232, fig. 25.

Material examined : Several worms collected from the Bugga stream, Cuddapah, in January 1956 ; from the Langford Town tank, Bangalore, in May 1958.

Worms minute, brownish, capable of high contractility, hence very short in preserved condition. Proboscis longer than prostomium with sensory hairs. Anterior 7 segments shorter than following segments. Anus posterior in a notch between 2 lobes with sensory hairs.

Dorsal setae from II on, 1 hair and 1 needle per bundle. Hairs nearly straight 91-175 μ long, longer than diameter of body. Needles (Fig. 33 A) finely bifid, 28-42 μ long, slightly curved distally, nodulus distal (D : P : : 4 : 8), teeth fine, short, diverging. Ventral setae (Fig. 33 B, C) 4-7 per bundle, higher number in middle segments, 38.5-52.5 μ long ; in II, 49-52.5 μ long, longer than rest, in III, 38.5 μ long and shortest. Nodulus proximal in II (D : P :: 8 : 7 or 8 : 6) and distal in others (D : P : : 5 : 7). Giant setae (Fig. 33 D) 1 per bundle in V, 70-77 μ long, single-pointed with double curve with shape resembling a pruning knife, nodulus strong and distal.

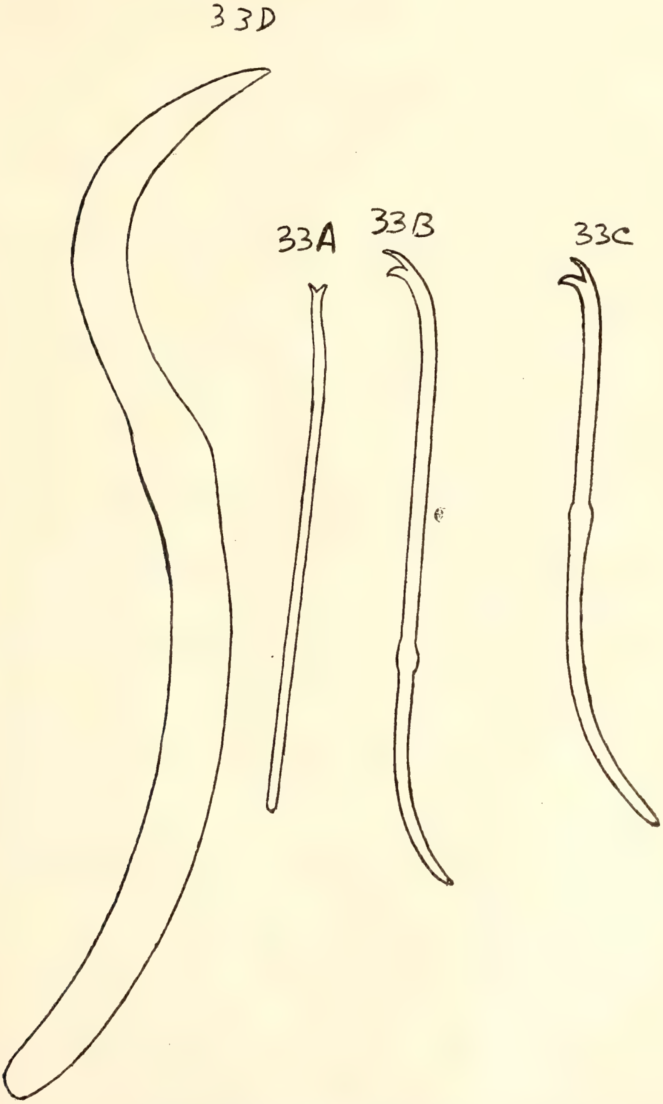

Fig. 33. *Pristina evelinae* Marcus : A. Needle seta × 2250 ; B. Ventral seta of II × 2250 ; C. Ventral seta of posterior segment × 2250 ; D. Giant Ventral seta of IV × 2250.

Pharynx in II-III, wide. Oesophagus in IV-VII, thin. Stomach abrupt and narrowing posteriorly with intracellular canals in VIII. Intestine from IX onwards. Coelomocytes granular, spherical, largest 12 μ in diameter. Septal glands in III-V, whitish.

Brain incised in front and behind.

Blood red. Dorsal vessel mid-dorsal all along. Transverse commissural vessels from II-VII, enlarged and contractile in VI and VII.

First nephridium in IX, placed to left, with its pre-septal nephrostome in VIII.

One budding zone develops at a time.

Sexual worms not encountered.

l (p.) = 1.1-1.4 mm.; d (p.) = 0.14 mm.; s = 22 + undifferentiated zone ; n = 13-14.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	91	101.5	108.5	112	129.5	129.5	140	175	140
Needle	28	29.7	35	35	36.7	35	38.5	42	38.5
	3:5	3.5:5	4:6	4:6	4:6.5	4:6	4:7	4:8	4:7
V. seta	52.5	38.5	42	70	45.5	42	42	42	42
	8:7	5:6	5:7	8:12	5:8	5:7	5:7	5:7	5:7

Distribution in Indian sub-continent : Travancore (S. India). Now recorded from Cuddapah and Bangalore (S. India).

Remarks : Lengths of setae of the present worms agree with those of Aiyer (1930) and Marcus (1943).

Habits : Swimming absent. Live in aquatic plants and algae.

34. **Pristina longiseta longiseta** Ehrenberg, 1828

Fig. 34 A-K

Pristina longiseta Ehrenberg. Pointner, 1911, p. 634 ; Stephenson, 1916, p. 304 ; 1922, p. 282 ; 1931a, pp. 41-42, fig. 2 ; Lastočkin, 1924, p. 5 ; 1927, p. 66; Sperber, 1950, p. 77, pl. III, fig. 9 ; 1958, p. 52, figs. 18-19.

Pristina longiseta Ehrenberg f. *typica* Michaelsen ; Lastočkin, 1918, p. 59 ; 1924, p. 5 ; 1927, p. 66.

Pristina longiseta longiseta Ehrenberg. Sperber, 1948, pp. 236-237, pl. XXI, figs. 2, 6.

Material examined : Numerous worms collected from the Bugga stream, Cuddapah, all round the year ; from the Ulsoor tank, Bangalore, in May 1958.

Worms small, slender and light yellow. Prostomium (Fig. 34 A, B) with a mobile proboscis, latter longer than former, both with sensory hairs. Anus posterior in a notch between 2 lobes with sensory hairs (Fig. 34 C).

Dorsal bundles from II onwards, each bundle with 1-3 hairs and 1-3 needles. Hairs of III specially elongated, straight non-serrate, highly

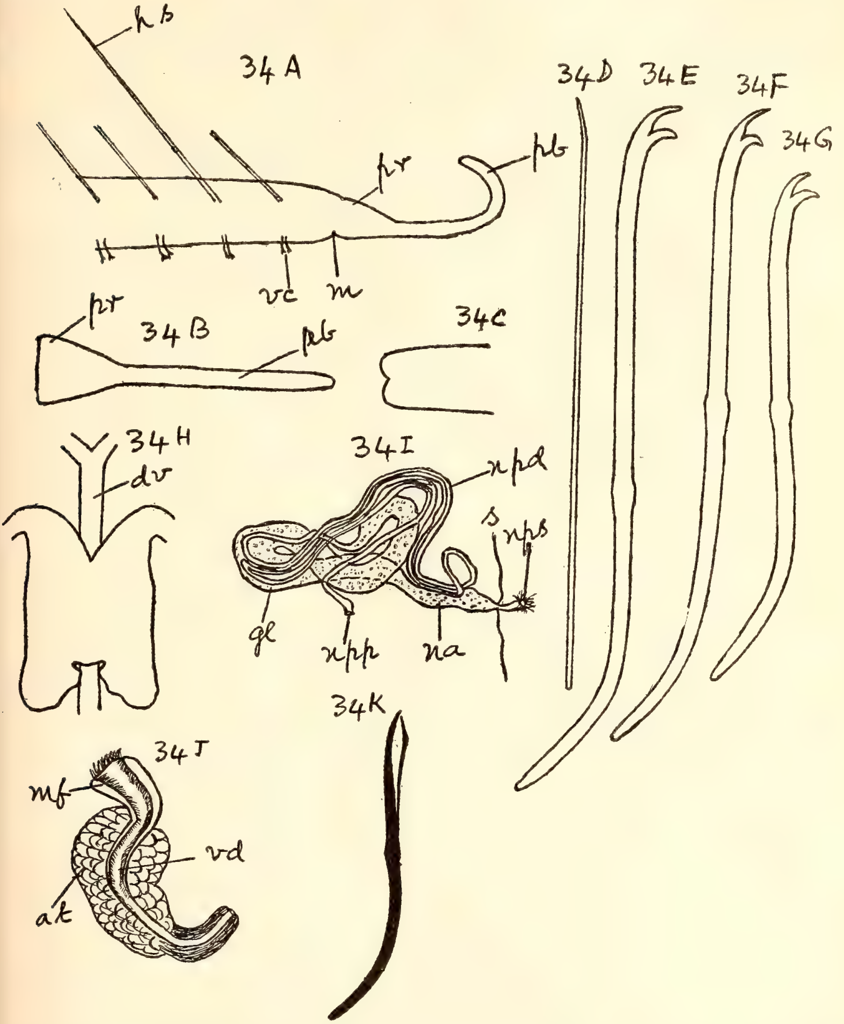

Fig. 34. *Pristina longiseta longiseta* Ehrenberg : A. Anterior part of the worm (lateral view) ; B. Prostomium (dorsal view) ; C. Posterior part of the worm (dorsal view) ; D. Needle seta × 1700 ; E. Ventral seta of II × 1700 ; F. Ventral seta of III × 1700 ; G. Ventral seta of posterior segment × 1700 ; H. Brain ; I. Nephridium ; J. Seminal funnel and atrium ; K. Genital seta × 650.

at : atrium ; *dv* : dorsal vessel ; *gl* : gland ; *m* : mouth ; *mf* : male funnel ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridiopore ; *nps* : nephrostome ; *pb* : proboscis ; *pr* : prostomium ; *s* : septum ; *vc* : ventral seta ; *vd* : vas deferens.

mobile, 658-714 μ long, reaching beyond tip of proboscis when turned forwards; in others nearly straight with close serrations on convex border, up to 315 μ long. Needles (Fig. 34 D) fine, straight with distal end simple pointed and curved, without nodulus, 35-49 μ long. Ventral setae (Fig. 34 E, F, G) 4-5 per bundle in anterior segments and 5-6 in later segments ; in II longest, 63-66.5 μ long ; in others 49-56 μ long. In II and III nodulus proximal (D : P : : 11 : 7) and prongs equally thick, distal prong 1½ times longer than proximal, in others nodulus median to distal (D : P : : 7 : 7 and 6 : 7), prongs of equal length, distal thinner than proximal.

Pharynx in II-III, ovoid and ciliated with a dorsal diverticulum communicated by a longitudinal slit in roof. Oesophagus in IV-VII, thin and wavy. Stomach in anterior half of VIII, abrupt pear-shaped, thick-walled with intracellular canals. Intestine narrow in IX, wide from X on. Chloragogues start in VI, greenish grey. Septal glands on septa 4/5, 5/6 and 6/7. Coelomocytes colourless, spherical of 10 μ diameter with greyish granules.

Brain (Fig. 34 H) incised deeply in front and less deeply behind.

Blood light yellow. Dorsal vessel contractile and mid-dorsal ; ventral vessel non-contractile and mid-ventral. Simple contractile lateral vessels in II-VII, later pairs larger and more contractile.

First pair of nephridia (Fig. 34 I) in IX with pre-septal funnels in VIII, each funnel connected by a neck to post-septal, consisting of fusiform ampulla followed by a coiled, ciliated duct, partly free and partly enclosed in gland tissue, and opening by nephridiopore.

One budding zone common, two rare, second budding zone always develops in anterior zooid 3-4 segments in front of first zone.

Clitellum from ½VII—½IX (2 segments). Testes ovoid and white, attached to posterior face of septum 6/7. Sperm-sac, back-pouching of septum 7/8 extends to XI when full. Ovaries not clearly seen. Ovi-sac, back-pouching of septum 8/9, extend to XII when full. Sperm-funnels (Fig. 34 J) with wide ciliated openings, vasa deferentia short and wide, slightly bent on themselves and opening into atria. Atrium ovoid and glandular with short, thick ectal duct opening ventro-laterally in VIII. Spermathecal ampulla long and cylindrical with short ducts opening ventro-laterally in VII. Ventral setae of VI replaced by a pair of genital setae (Fig. 34 K) of 80 μ long, each with 2 long prongs converging distally.

As in *Stylaria fossularis* worms developing sex organs go through asexual reproduction repeatedly producing fission zones.

l (living) = 2-3 mm. (simple), 4-5 mm. (chain) ; d (living) = 0.12 mm. ; s = 22-26 ; n = 14-17.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hair	161	714	178.5	196	217	70	63	241.5	245	245	255.5
Needle	35	42	42	45.5	45.5	45.5	49	49	49	49	49
V. seta	63	52.5	49	49	45.5	56	52.5	52.5	52.5	52.5	52.5
	11:7	8:7	7:7	7.5:6.5	7:6	8:8	7.5:7.5	7.5:7	8:7	8:7	8:7

Distribution in Indian sub-continent : Calcutta (N. India) ; Bheemanagar, Trivandrum (Travancore, S. India) ; Bombay (W. India) ; Gwalior (C. India) ; Lahore (Pakistan). Now recorded from Cuddapah and Bangalore (S. India).

Parasites : Sporocysts of the microsporid sporozoan, *Mrazekia caudata* Leger & Hesse (Naidu, 1959a), were found in the coelom of two worms and of the actinomyxid sporozoan, *Triactinomyxon* sp. (Naidu, 1959b) were found in the gut wall of one worm.

Habits : No swimming. Backward progression present. Live in algae.

Remarks : Lengths of setae of the present specimens agree with those of the Swedish worms. Genital setae agree with those of Aiyer (1930).

Pristina longiseta Ehrenberg from W. Australia (Jackson, 1931) and *Pr. longiseta* Ehrenberg f. *typica* Michaelsen from East Indies (Michaelsen & Boldt, 1932) are probably identical with the present species. To determine their identity a re-investigation of the forms is necessary.

35. **Pristina sperberae**[1] sp. nov.

Fig. 35 A-D

Material examined : A few worms collected from the Bugga stream, Cuddapah, in October 1953, January 1954 and 1956.

Worms minute, slender, and whitish. Prostomium with proboscis, latter slightly longer than prostomium and does not snap. Both prostomium and proboscis bear sensory hairs. Eyes absent.

Dorsal bundles start in II, each bundle composed of 1 hair and 1 needle. Hairs non-serrate, nearly straight, 100-190 μ long, in III not specially elongated but slightly longer than hairs of II and slightly shorter than those of IV. Needles (Fig. 35 A) bifid, 28-35 μ long, with weak distal nodulus (D: P : : 2 : 10), curved above nodulus, with fine unequal and diverging teeth. Ventral setae (Fig. 35 B, C) 7-8 per bundle in anterior 7 or 8 segments, gradually decreasing to 4 posteriorly ; in II, 43.8-45.5 μ long, longer than the rest, with proximal nodulus and distal prong longer than proximal ; in III shortest 35-36.7μ long, with median nodulus (D : P : : 5 : 5.5) ; in others 38.5-45.5 μ long, with distal nodulus (D : P : : 5:7). Prongs about equal in thickness, distal longer than the proximal in anterior 7 segments, and prongs equally long, distal thinner than proximal in rest.

Pharynx in II-III, wide and ciliated, with eversible roof. Oesophagus in IV-VII, thin and wavy. Stomach in VIII abrupt, pear-shaped with intracellular canals. Intestine thin and sinuous up to X, wide and sacculated from XI. Chloragogues start in VI, greenish grey. Coelomocytes morula-like, spherical with grey granules. Septa well developed, septal glands on septa 4/5, 5/6 and 6/7.

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[1] Named after Dr. Christina Sperber of Uppsala, Sweden, for her valuable contribution on the taxonomy of the Naididae.

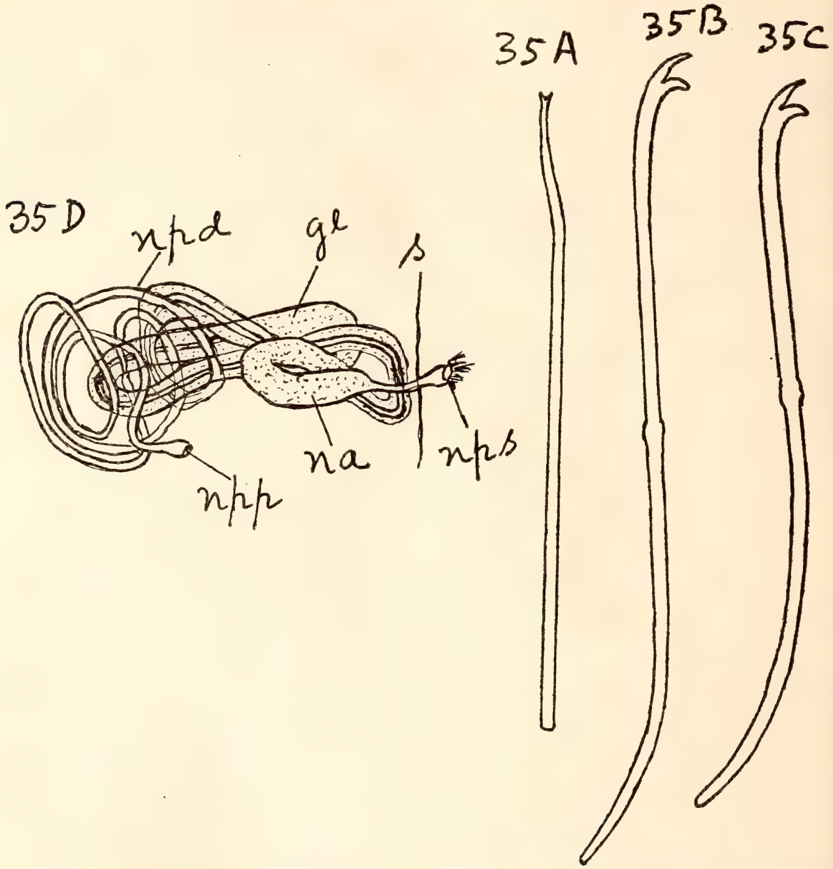

Fig. 35. *Pristina sperberae* sp. nov. : A. Needle seta × 3000 ; B. Ventral seta of II × 3000 ; C. Ventral seta of VIII × 3000 ; D. Nephridium.

gl : gland ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridiopore ; *nps* : nephrostome ; *s* : septum.

Brain incised deeply behind and less deeply in front.

Blood tinged with yellow. Dorsal vessel median on gut, covered partially by chloragogues and contractile. Transverse commissural loops in II-VII. Ventral vessel mid-ventral and non-contractile.

First pair of nephridia in IX and 1 in each of the succeeding segments. Each nephridium (Fig. 35 D) has pre-septal with nephrostome and a post-septal with a fusiform ampulla followed by a long, coiled, ciliated duct, partly passing through gland tissue and partly free, ending in nephridiopore.

One budding zone develops at a time.

Sexual worms not encountered.

l (living) = 1.5-2 mm. ; d (living) = 0.12 mm. ; s = 20 ; n = 14-15.

Lengths of longest setae in μ and position of nodulus in the ratio D : P : :

	II	III	IV	V	VI	VII	VIII	IX	X
Hair	98	101.5	122.5	164.5	154	164.5	189	185.5	185.5
Needle	28	31.5	35	35	35	35	35	35	35
	1.5:6.5	2:7	2:8	2:8	2:8	2:8	2:8	2:8	2:8
V. seta	45.5	36.7	45.5	43.7	42	42	40.3	38.5	38.5
	8:5	5:5.5	6:7	6:6.5	5:7	5:7	5:6.5	4.5:6.5	5:6

Type : The type specimen is being deposited with the Zoological Survey of India, Calcutta.

Habits : Lives among water plants and filamentous algae. No swimming.

Commensals : Sessile vorticillids are found attached to ventral setae.

Taxonomic remarks: The present species closely resembles *Pr. foreli* out of the 21 species recognized for the genus (Sperber, 1948). It differs from the latter in having lesser number of hairs and needles per bundle, (1 hair and 1 needle as against 1-4 hairs and 1-4 needles), smaller size of body (2 mm. as against 3-6.5 mm.), simple hairs (non-serrate as against serrate hairs), with shortest ventral setae in III (as against setae of normal length in *Pr. foreli*). Hence it is described here as a new species.

Diagnosis of Pristina sperberae *sp. nov.* : Prostomium with proboscis. Eyes absent. Dorsal setae from II on, 1 non-serrate hair and 1 bifid needle with fine teeth, weak distal nodulus and slight curve distally. Ventral setae 4-8 per bundle, of II longer and of III shortest with proximal nodulus ; in the rest nodulus distal ; in II-VII distal prong longer than proximal, from VIII prongs equally long. Stomach in VIII, pear-shaped with intracellular canals. Dorsal vessel mid-dorsal. Transverse commissural vessels in II-VII. n = 14-15 ; s = 20.

VI. SUMMARY

Till 1958 the aeolosomatids and naidids known for the Southern region and Indian sub-continent were 27 and 36 species respectively. Recording of 18 species in this paper for the Southern region has established 45 species for the region and 54 species for the sub-continent [cf. pp. 643-644, *J. Bombay nat. Hist. Soc.* 58 (3)].

The thirty-five species treated here include 7 new species, and 11 new records for the Southern region, inclusive of 2 new records for the Indian sub-continent. They are *Nais menoni* sp. nov., *Dero indica* sp. nov., *D. plumosa* sp. nov., *Aulophorus hymanae* sp. nov., *A. indicus* sp.

nov., *Allonais rayalaseemensis* sp. nov., and *Pristina sperberae* sp. nov. The new records for the Southern region are all 3 species of *Chaetogaster, Stylaria fossularis, Haemonais waldvogeli, Dero cooperi, D. sawayai, Allonais gwaliorensis, Pristina minuta, Pr. jenkinae,* and *Pr. aequiseta.* Of these *Dero sawayai* and *Pristina jenkinae* are new records for the Indian sub-continent.

All the 35 species treated here were collected by the author in the ten localities [see p. 640, *J. Bombay nat. Hist. Soc.* **58** (3)]. A record collection of 32 species belonging to the Aeolosomatidae and Naididae was made from the Bugga stream, Cuddapah. From the other localities 1-11 species of worms were collected. Geographical distribution of all the forms is tabulated [see pp. 643-645, *J. Bombay nat. Hist. Soc.* **58** (3)].

The section on systematics deals with the descriptions of new species and redescriptions of known species of worms. *Lastočkinia* gen. nov.[1] is created for an aberrant species, *Aeolosoma niesvestnovae* Lastočkin, with its diagnosis. Stephensonianinae nov. is created for the reception of a solitary genus *Stephensoniana* Černosvitov, with its diagnosis. Key to all the genera of the Aeolosomatidae, key to all the known and valid species of *Aeolosoma* are given. Also, the key to subfamilies of the Naididae, keys to all the genera of the subfamilies, and keys to all the known and valid species of *Chaetogaster, Nais, Stylaria, Branchiodrilus, Allonais, Pristina, Dero*, and *Aulophorus* are given. Diagnostic characters of twelve genera and subgenera treated here are given.

Description of each species includes external characters, details of setae, internal anatomy, budding zones, sex organs, habits of worms, etc. Prostomium is rudimentary in *Chaetogaster*, simple and triangular in others except in *Stylaria fossularis* and *Pristina* (except in *Pr. minuta* and *Pr. jenkinae*) which have antero-median proboscis. Eyes are present only in *Nais communis* and *Stylaria fossularis.*

Dorsal bundles of setae begin in II in *Pristina, Stephensoniana trivandrana* ; from IV in *Dero dorsalis* ; from V in *Aulophorus* (except in *A. tonkinensis*); from VI in *Dero, Stylaria fossularis,* all *Nais, Allonais,* and *Aulophorus tonkinensis* ; from V or VI in *Branchiodrilus semperi.* They are absent in *Chaetogaster.*

Hair setae plumose in *Dero plumosa* sp. nov., bayonet-shaped in 15 species, and straight or slightly curved in 16 others. Needle setae are simple-pointed in *Aeolosoma, Stylaria fossularis, Branchiodrilus*

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[1] Ruttner-Kolisko (1955) has created genus *Rheomorpha* to receive the aberrant species *Aeolosoma neisvestnovae* Lastočkin. Hence *Lastočkinia* gen. nov. [see pp. 645-646, *J. Bombay nat. Hist. Soc.* **58** (3)] created in the present paper to receive the above species is invalid and the name *Lastočkinia* is *nomen nudum.*

semperi, Stephensoniana trivandrana, and *Pristina longiseta longiseta* ; in the first two they are bayonet-shaped, in the later two they are straight, in the last two they are straight but with distal part curved. Needle setae are pectinate in *Aulophorus indicus* and *Allonais inaequalis,* oar-shaped in *Aulophorus tonkinensis,* and bifid with sickle or bayonet-shape in others. Giant ventral setae are observed in IV of *Pristina aequiseta* and in V of *Pr. evelinae.* Penial setae are observed only in *Nais communis, Stylaria fossularis,* all species of *Allonais* ; and genital setae in *Pristina longiseta longiseta* among those in which the sexual worms were examined.

Gilled forms are *Branchiodrilus semperi* with dorso-lateral gills in anterior and middle segments ; all species of *Dero* and *Aulophorus* with gills situated posteriorily in branchial fossa.

Stomach is absent in *Haemonais waldvogeli, Branchiodrilus semperi, Dero dorsalis, Aulophorus furcatus, A. michaelseni, A. hymanae,* and *Stephensoniana trivandrana.* Intracellular canals observed in stomachal wall of *Pristina aequiseta, Pr. evelinae, Pr. longiseta longiseta,* and *Pr. sperberae* are absent in *Pr. synclites,* and are not known from *Pr. minuta* and *Pr. jenkinae.* Anti-peristalsis and ascending ciliary vibration of intestine occur in all the species treated here except in *Chaetogaster.*

Dorsal vessel is mid-dorsal in *Aeolosoma, Chaetogaster,* and *Pristina* (lateral in *Pr. synclites*), and ventro-lateral in all others. Blood is colourless in *Aeolosoma* and *Chaetogaster,* and coloured in others, the colour varying from pale yellow to bright orange-red. Statocyst in the brain, hitherto not reported, is reported for *Chaetogaster cristallinus.*

Nephridia commence in II or III in *Aeolosoma,* in VI or VII in *Chaetogaster,* in VI in *Stephensoniana trivandrana,* in VIII or IX in *Aulophorus tonkinensis,* in X in *Aulophorus indicus,* in XII in *Branchiodrilus semperi,* in IX in *Pristina,* and in VII or VIII in all others. They are exonephric in *Chaetogaster* and coelomonephric in others.

Asexual reproduction is by formation of budding zones in all species treated here except in *Allonais,* where fragmentation occurs. Prostomium and 4 anterior segments are produced in *Stephensoniana trivandrana,* 7 in *Pristina,* and 5 in all others. The anterior segments of the posterior zooid start budding only after complete formation of the hind part of the anterior zooid in *Pristina synclites.* Positions of testes and spermathecae, and ovaries and atria are in VII and VIII in *Pristina longiseta longiseta,* and in V and VI in others in which sexual worms were examined.

Among the Naididae the species of *Dero* and *Aulophorus* are known to construct tubes of mucus and foreign matter to live in. Of the 8 species of *Dero* and 5 species of *Aulophorus* treated here all were observed to live in tubes except 3 species of *Dero* and 2 of *Aulophorus. Stephensoniana trivandrana* lives in soft mud and has a part of its body covered by thin mucus film studded with mud particles. Among the species of *Aeolosoma, Ae. travancorense* live in tubes much larger than their body, evidently tubes vacated by larger species of worms.

Swimming was observed in *Nais menoni* sp. nov., *Stylaria fossularis*, all species of *Dero, Aulophorus, Allonais* (except in *Dero dorsalis* and *Aulophorus indicus*) and in *Stephensoniana trivandrana.* Species of *Aeolosoma* glide on substratum like turbellarians. *Chaetogaster cristallinus, Ch. diastrophus,* all species of *Nais, Allonais, Pristina* (except *Pr. synclites*), and *Stylaria fossularis* live in filamentous algae and water plants ; others live in soft mud. *Chaetogaster langi* lives in encrustations of plant and animal matter.

Vorticellids were observed as commensals attached to the setae of *Chaetogaster cristallinus, Nais communis, Dero digitata, Aulophorus hymanae, Allonais gwaliorensis,* and *Pristina sperberae.* Some holotrichous astomatous ciliate parasites were found in the gut of *Aeolosoma travancorense, Chaetogaster cristallinus, Allonais gwaliorensis,* and *Stephensoniana trivandrana*; sporocysts of actinomyxid sporozoan parasites were found in the gut wall of *Nais communis* and *Pristina longiseta longiseta* ; and sporocysts of microsporid sporozoan parasites were found in the coelom of *Nais communis, Dero sawayai,* and *Pristina longiseta longiseta.*

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* Not seen in original.

The Early Stages of Development in *Achatina fulica* Bowdich (Mollusca : Gastropoda)

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(*With three plates*)

INTRODUCTION

Records on the early stages of *Achatina fulica* are far from complete. Rees (1950) described these stages briefly and Bequaert (1950) recorded only some of the features of young shells. Snails bred and reared in the laboratory (Ghose, 1959) attain sexual maturity at the age of about six months, but in nature they require more than one year to attain the same phase as aestivation starts when they are three to four months old or even still less.[1] The coloration of the adult shell is influenced to some extent by the climatic conditions in different countries, but sunlight seems to have no effect on pigmentation during early stages of growth.

OBSERVATIONS

Since eggs with embryos in different stages of development are laid, the period of hatching out of the snails is variable. In a brood, the first young snail comes out of the egg within 1 to 14 days after laying, and most of the embryos hatch out within a further period of seven days. Hatching may continue in some cases for about a week more. The healthy individuals come out first, and only the weaker and smaller ones, especially those from the small eggs, emerge later. The percentage of hatching in the eggs laid with embryos in late stages of development is 82.5, whereas in the eggs laid with embryos in early stages of development it is only 26 approximately.

The egg shells lose their brilliance and toughness considerably during incubation; they become fragile and can be easily broken by

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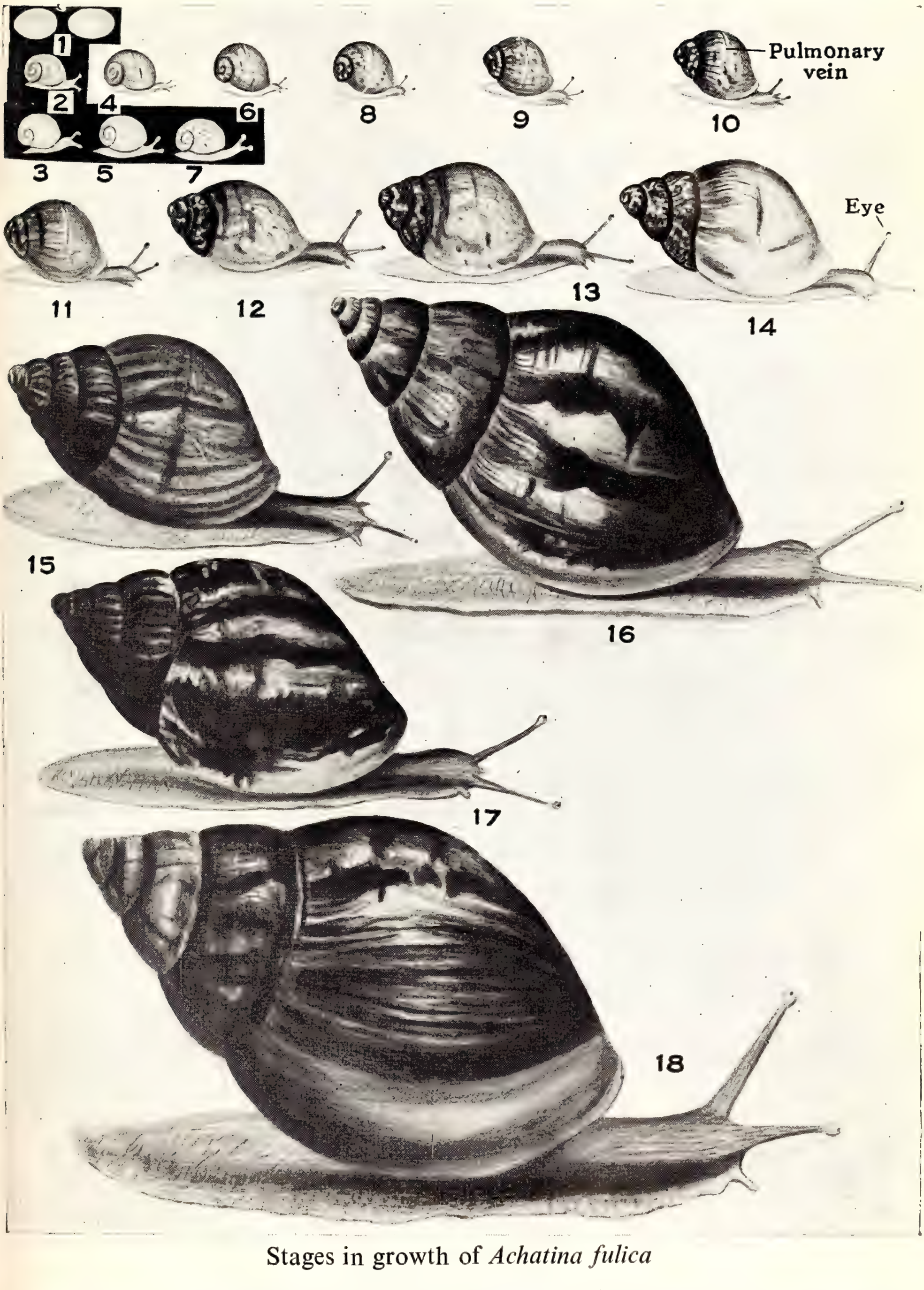
[1] This depends on the period of time between the hatching out of the young snail and the appearance of dry and cold weather.


1
2
3
4
5
6
7
8
9
10
Pulmonary vein
11
12
13
14
Eye
15
16
17
18

Stages in growth of *Achatina fulica*

1. Eggs; 2. Newly hatched snail 4 mm.; 3. Same as Fig. 2 (shell removed); 4. 4.5 mm. snail; 5. Same as Fig. 4 (shell removed); 6. 5 mm. snail; 7. Same as Fig. 6 (shell removed); 8. 5.5 mm. snail; 9. 6.5 mm. snail, 8 days old; 10. 8 mm. snail; 11. 9. mm. snail, 16 days old; 12. 12 mm. snail, 24 days old; 13. 15 mm. snail, 32 days old; 14. 18 mm. snail, 46 days old; 15. 24 mm. snail, 60 days old; 16. 31 mm. snail, 74 days old; 17. 38 mm. snail, 88 days old; 18. 48 mm. snail.

the pressure of the foot of the young snails. The young snails come out in most cases carrying broken egg shells on their back. The cracking of the shells with a sharp click (Rees, 1950) at this stage was never heard by me.

Some of the newly hatched snails remain inactive for a few hours, while others are active from the moment of hatching. They show considerable variation both in the size of the shell and in that of the body. In most cases, the young snails begin feeding on soil, leaves of plants, and broken egg shells, lying on the soil or on the backs of other young snails, and in this way they meet their demand for calcium, which is very high in the early stages. While feeding on leaves, they scrape off their surface and make small holes in them.

Snails in captivity thrive well on lettuce, mustard, cabbage, cauliflower, and various types of leafy vegetables. I never found young snails cannibalistic as observed by Rees (1950).

In spite of all possible care mortality is very high among young snails being about 85.2 per cent. In a batch of 425 snails, only six survived to reach sexual maturity. The death rate is highest in very early stages; it then comes down gradually but again sharply increases in the first few weeks of aestivation. In India, the cold and dry period comes when the snails are young; this acts as an effective check on the increase of *Achatina* population. The growth rate is nearly uniform up to the attainment of sexual maturity, and slows down subsequently which is shown in Plates II and III.

The measurement (in mm.) and weight of four snails, three months old, are given in the table below:

Sl. No.	Shell		No. of spirals	Aperture		Weight of the living snail in gr.
	Length in mm.	Breadth in mm.		Length in mm.	Breadth in mm.	
1	38	22	6	22	15	7.9
2	37	21	6	21	12	6.6
3	36.5	21	6	22	13	7.3
4	34	20	6	20	11	5.1

FEATURES OF THE EARLY STAGES

Stage 1. (Newly hatched snail) (Pl. I, Fig. 2)

The shell is globose, very thin, almost transparent, glossy, without any decussation, and of uniform light horny colour. The first whorl is very small, but the next one is quite large.

The colour of all the organs except eyes (black), kidney (cream-white), and digestive gland (light brown) is almost glass-like. In the larger snails (4 mm. and above), which constitute about ten per cent of the total, black pigment in the form of small rods and dots is scattered irregularly on the mantle over the pleuropedal visceral mass.[1] Reticulation on the body is entirely absent. The heart, kidney, and pulmonary vein are distinctly visible through the shell. The heart-beat of some snails at this stage may be as low as 20 per minute[2].

Young snails are very active and begin to feed on soil[3]. Their activity increases during the night.

From the fourth day onwards, very light brown pigment begins to be deposited on the dorsal surface of the visceral stalk and foot, and reticulation appears on the dorsal surface of the visceral stalk.

Stage 2. (Age 8 days) (Pl. I, Fig. 9)

The ground colour of the shell is uniformly light horny. Fine vertical wrinkles, not visible to the naked eye, appear on the post-nepionic whorl. Narrow, almost parallel, very faint light-brown, vertical stripes run from suture to columellar lip. Black pigmentation on the mantle increases; the digestive gland becomes brownish black and occupies the first two whorls; kidney yellowish, and foot cream-white. Light brown pigment appears on the visceral stalk, ventral tentacles, ocular tentacles, and dorsal surface of the foot. Pigmentation is heavier on the dorso-lateral sides of the visceral stalk, posterior to ocular tentacles and at the junction of the visceral stalk and foot.

The snails are very active, especially during rain. Feeding takes place mainly at night, and leaves are eaten from the margins. They can consume comparatively hard substances like germinating pea and gram seeds. Occasionally, the snails burrow holes in the soil and rest there.

Stage 3. (Age 16 days) (Pl. I, Fig. 11)

The shell appears thicker and more opaque with a flexible and greyish horn lip. White patches in the form of small rods and dots placed at regular intervals appear on the apical visceral mass. The

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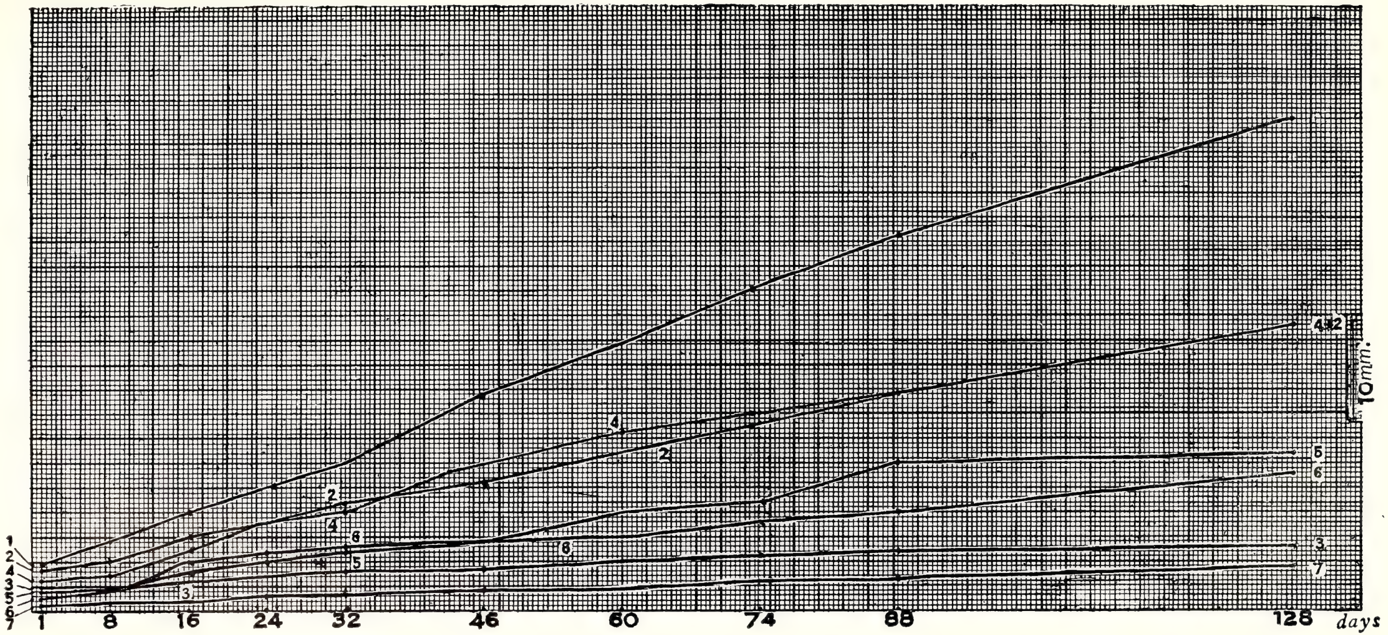
[1] In order to ascertain the effect of sunlight on the deposition of pigments, eggs were kept in a dark room. The young snails hatched and reared in the dark did not exhibit any difference in their pigmentation when compared with the controls.

[2] The maximum heart-beat in the larval stage was noted to be 150 per minute.

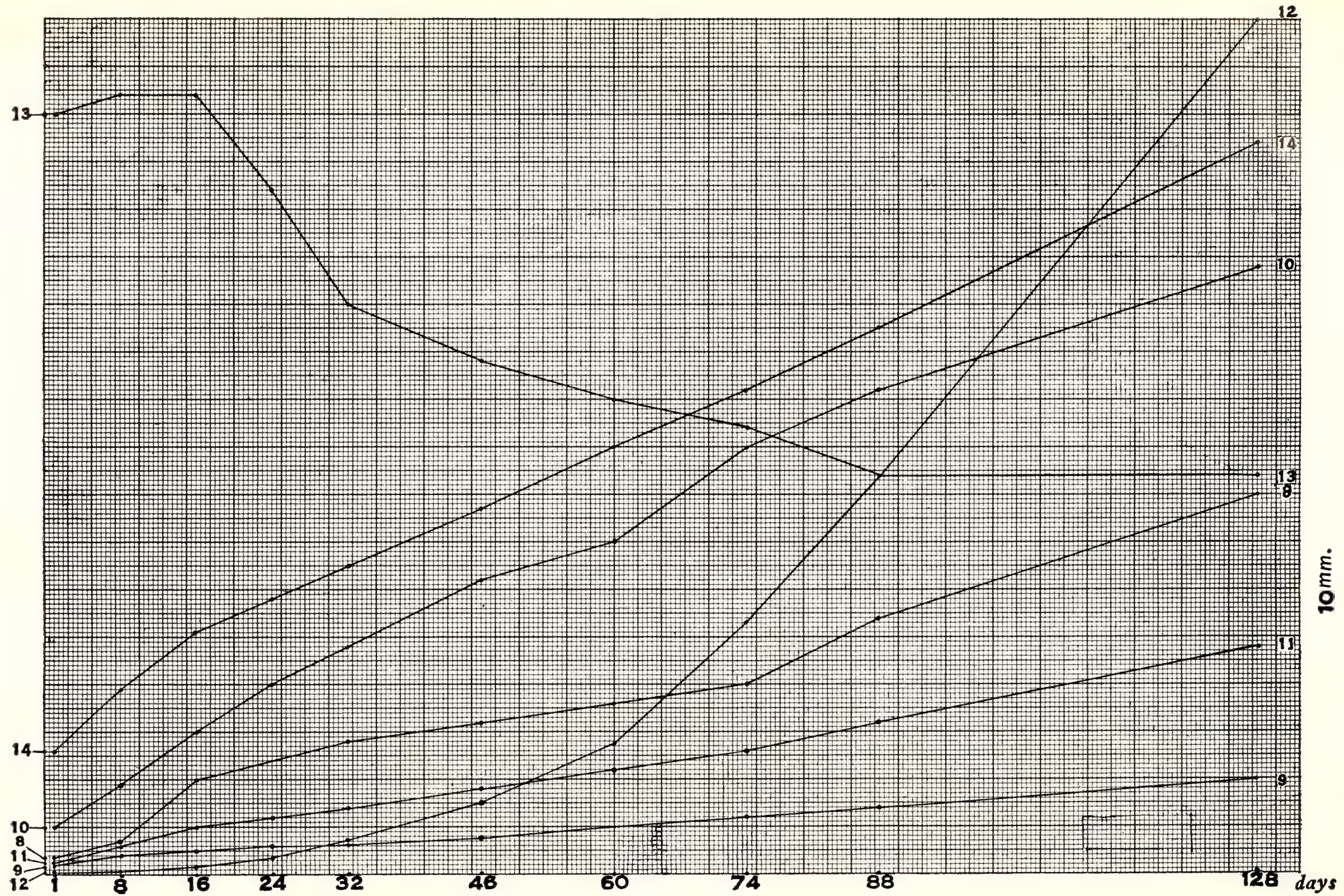
[3] Embryos not allowed to come in contact with soil did not thrive well. So it appears that they obtain the supply of certain requirements of their early stages from the soil.



Graphs showing the rates of growth of the shell, aperture, and tentacles in *Achatina fulica*

Graph 1. Length of shell; 2. Breadth of shell; 3. Number of spirals; 4. Length of aperture; 5. Breadth of aperture; 6. Length of ocular tentacle; 7. Length of ventral tentacle.

(In graphs 1, 2, and 4-7, two small divisions represent 1 mm.; in graph 3, two small divisions represent 1 spiral.)



Graphs showing the rates of growth of the visceral stalk and foot, weight, heart-beat, and movement in *Achatina fulica*

Graph 8. Length of visceral stalk ; 9. Breadth of visceral stalk ; 10. Length of foot ; 11. Breadth of foot ; 12. Weight ; 13. Rate of heart-beat per minute ; 14. Rate of movement per minute.

(In graphs 8-11, two small divisions represent 1 mm. ; in graph 12, one small division represents 100 mg. ; in graph 13, two small digestive gland occupies almost the whole of the first two and one-fourth whorls. The colour of the tentacles is like that of the visceral stalk. Pigmentation on the foot increases to light brown, and reticulation appears on it.

Stage 4. (Age 24 days) (Pl. I, Fig. 12)

The shell loses its globose shape, but it cannot yet be called elongate. This stage resembles the stage number 3 in every respect except that the pigmentation on the body becomes deeper and the reticulation on the visceral stalk appears more prominent.

Stage 5. (Age 32 days) (Pl. I, Fig. 13)

The shell is slightly elongate. It loses its glossy appearance and is light roseate in colour with increased opacity. The vertical wrinkles on the body whorl are slightly bent at the sutures. The brown stripes on the body-whorl are deeper but, instead of running from suture to columellar lip, stop at the middle, being slightly deflected at the end. The white spots on the apical visceral mass and the black pigment on the pleuropedal visceral mass assume elongated appearance and form small scattered stripes. Pigmentation on the rest of the body approaches a deep brown colour. The foot is light brown. Reticulation on the foot and visceral stalk is very prominent.

Stage 6. (Age 46 days) (Pl. I, Fig. 14)

The shell is elongate-ovate, the apex forming a broad cone. The vertical wrinkles are cut by a few incised lines. The brown stripes are broad and deeper and fraying appears at the margins. The digestive gland shifts its position, and the first whorl of the shell becomes empty. The pigmentation on the apical and pleuropedal visceral mass is no more visible. Pigmentation and reticulation on the body and foot increase, and the foot is brown in colour.

Stage 7. (Age 60 days) (Pl. I, Fig. 15)

The shell is still partially transparent. The shape and pigmentation of the shell nearly approach those of an adult. Similarly, the reticulation on the foot and visceral stalk is almost like that of an adult. The colour of the exposed parts of the body is deep brown.

Stage 8. (Age 74 days) (Pl. I, Fig. 16)

Pigmentation on the body and the shell is adult-like.

Stage 9. (Age 88 days) (Pl. I, Fig. 17)

It resembles an adult in every respect. Only the heart can be seen through the shell against light[1].

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[1] The heart-beat can be counted through the shell up to the age of four and half months.

Richard Watkins Burton

Obituary

LIEUTENANT-COLONEL RICHARD WATKINS BURTON

(*With a photograph*)

With deep regret we record the death at Woodcote Park, Surrey, England, of this old and valued member of our Society. He died on the 12th January 1963 in his 95th year.

Richard Burton was the sixth son and seventh child of the late General E. F. Burton of the Madras Staff Corps and Georgiana his wife. All the nine sons followed their father's profession.

Commissioned from Sandhurst in the 1st Battalion of the Lancashire Fusiliers on the 23rd March 1889, he was transferred to the 2nd Battalion in India and landed at Bombay on the 5th April 1890. On being posted to the Indian Army he joined at Belgaum on the 16th December 1890. After serving in Burma he was appointed to the Hyderabad Contingent at Aurangabad in 1891.

Permanently crippled by a riding accident in December 1903, he was saved from half-pay on the understanding that he would enter the Cantonment Magistrate's Department. After various assignments under the Foreign Department of the Government of India he was appointed to the Cantonment Magistrate's Department in 1906.

Col. Burton joined the Bombay Natural History Society in 1893 and was, at the time of his death, our oldest member. He wrote for the *Journal* regularly during the 70 years of his membership, his last contribution being in Volume **58** (3) in 1961. Throughout his long connection, Col. Burton was a staunch supporter and well-wisher of the Society. His note on the Duties of Members of the Society (Vol. **53** : 507), a confession of faith which he himself discharged in full measure, needs to be read and re-read and acted upon by all members. Among his nearly 200 contributions—original articles, compilations, miscellaneous notes, and book reviews—some of special interest and importance are the following:

Notes from the Oriental Magazine—New Series—1869 to 1879. Vol. 25 : 491.

Notes from the Oriental Sporting Magazine—New Series—June 1828 to June 1833. Vol. 26 : 309.

Three months up the Valley of the Sutlej River. Vol. 31 : 23; 31 : 352.

The Indian Wild Dog. Vol. 41 : 691.

On the banks of the Narbada. (Compiled from the Note Books of Major H. G. H. Munrowd.) Vol. 42 : 757; 43 : 48.

Some Reminiscences of Sport in Assam. Vol. 45 : 199; 45 : 321; 45 : 485; 46 : 108; 46 : 269.

Wild Life Preservation : India's Vanishing Asset. Vol. 47 : 602.

Preservation of Wild Life in India: Supplement to the article published in Vol. 47, pp. 602-622 of this Journal. Vol. 48 : 290.

A History of Shikar in India. Vol. 50 : 845.

Wild Life Preservation in India (Text of the farewell address given to members of the Bombay Natural History Society at Bombay on 15 April 1953). Vol. 51 : 561-578.

The Ahmedabad Tent Club in earlier days. Vol. 51 : 732.

His shikar articles are not merely chronicles of success or failure in killing; most of them carry a lesson which has helped many a novice or less experienced sportsman to keep out of trouble. They contain valuable field observations on the habits and behaviour of the quarry —information of the type that forms the core of our knowledge of the natural history of Indian game animals. By means of a rather elaborate but extremely efficient cross-referenced index of the *Journal* from its inception, which he prepared for his own use and meticulously kept up-to-date almost to the end, he could put his finger immediately on anything and everything that had ever been published in previous volumes. The editors had reason to be thankful to him again and again for the promptness with which he could refer them back, when in difficulty, to the exact volume and page. He generously offered this index to the Society for publication for the benefit of its members, but on scrutiny it was found to need so much editing and simplification before any one but himself could make proper use of it, that the offer had to be regretfully declined.

Col. Burton was a fearless big game hunter, a keen and knowledgeable fisherman, and an ardent upholder of the highest ethics and traditions of sportsmanship. And he had lived through many thrilling encounters with wounded or man-eating tigers and panthers, and runaway shikar elephants, and survived a serious mauling by a wounded bear. Once he almost lost an eye, and indeed very nearly his life, when the bolt of a much-advertised new type of magazine rifle with the 'Straight Pull' action—all the rage at the time—blew back and took away with it a large part of his cheek. The deformity caused by this accident he carried the rest of his life. In his later years he dedicated himself with missionary zeal to the cause of nature conservation and wild life preservation. To him, perhaps more than to any other single individual, must go the credit for awakening the public conscience to the urgent need for practical conservation during the early years of our independence when conditions were somewhat disorganized and the wild life position in the country looked particularly bleak. His formal campaign for the preservation of wild life in India may be said to commence with the publication in the *Journal* of his article 'Wild Life Preservation : India's Vanishing Asset' in 1948. This article, reprinted in pamphlet form, was widely circulated among governmental circles—from the Prime Ministers of India and Pakistan down to many individual forest officers—also among sportsmen, game associations, and influential politicians and private citizens throughout the newly partitioned countries, often with a personal covering letter from the author himself or from the Society. The matter was also widely publicized through the press. Although no immediate response was apparent—partly owing to public and official apathy and lack of vision, partly to other important preoccupations following upon the political change-over—there is little doubt that in the long run the effort did contribute towards drawing attention to the deteriorating state of affairs. It paved the way for the formation of the Indian Board for Wild Life which, at least on paper and in an advisory capacity, is today the central agency responsible for governmental policy pertaining to wild life preservation in the country.

In 1949 in Vol. 48 (2) he published a supplement to the above article which added considerably to its value and completeness. This was followed up in October 1950 by a Memorandum to the Under Secretary, Government of India, Ministry of Scientific Research, New Delhi, for the use of the Advisory Committee for coordinating scientific research charged with examining the question and suggesting ways and means for setting up National Parks and Wild Life Sanctuaries in India. In 1953, with the financial sponsorship of H. H. the Maharaja of Mysore, who meanwhile had been nominated President of the newly formed Indian Board for Wild Life, Col. Burton prepared a compendium indexing, summarizing, or reproducing all the more important articles on wild life preservation in India that had appeared in the *Journal* since its inception. This booklet forms an indispensable, handy reference and guide for everyone interested in the problem.

Col. Burton was perhaps the last of the illustrious band of 'Anglo-Indian' sportsmen-naturalists who, by their unquenchable thirst for scientific enquiry, contributed so significantly to what may be termed the 'marginal gains' of game shooting in India, namely a knowledge of the natural history of the animals they hunted. At the same time they built up and codified exemplary traditions and ethics of sportsmanship which it seems imperative to inculcate and encourage, and even scrupulously enforce, among shikaris of the present generation, if wild life in this country is to be saved from early total extinction.

S.A.

Reviews

1. FLOWERING TREES OF THE WORLD FOR TROPICS AND WARM CLIMATES. By Edwin A. Menninger. pp. xv+336 (25×20 cm.). With 425 plates in full colour and 40 line drawings. New York, 1962. Hearthside Press Incorporated. Price $ 18.95.

The author has spent more than twenty-five years in a search for beautiful flowering trees to introduce into South Florida. The hunt involved the study of the extensive botanical literature of all the tropical countries—nearly 150 references are mentioned in the bibliography appended to the text. More useful for his purpose, however, was personal correspondence with residents and workers in the various countries. The collection of seed at the appropriate time, often in places remote from human habitation, the proper handling of it after collection, and its packing and despatch by air to its destination abroad involved a considerable expenditure of time and effort, and it speaks very well for the innate goodness of human nature that the author found ready co-operation from those whom he approached. Perhaps, the labour was not without its humour, witness the correspondent in Madagascar whose parcel of *Harpagophytum grandidiere* seeds was accompanied by the warning: 'Open and handle with great care'. One look at the seeds was sufficient. Thorns recurved like fish-hooks made the seeds dangerous to any living creature which might brush against the plant or step on a pod, and the box was hastily taken to the back lot and burnt!

Incidentally, the author gives an account of how he discovered the proper treatment for the seeds of the Teak (*Tectona grandis*)—I mention this as it is of interest to us in India:

> 'These seeds are about the size of garden peas, but each one is covered with a thick corky rind, making the whole as big as a marble. The seeds were dry, so were placed in a glass of water to be soaked overnight, but they were so buoyant that the water failed even to wet their surfaces. Another glass jammed into the first kept the pellets under water, but next morning when released they popped to the top as dry as ever despite the immersion. Out came a knife and file, and a lot of the corky rind was cut away. The seeds were soaked another 24 hours, then planted. No germination. Every few days an exploratory dig showed that nothing was happening. Perusal of some Indian books turned up a chapter in Cleghorn on 'How to Grow Teak Trees from Seed'. This sounded pertinent and the 18 pages were greedily devoured ; about all the book said was that germination was difficult. However, a gleam of light emerged from one sentence. Observers had found, the book said, that after the annual brush fires swept through the teak

> forests of Burma, an immediate upcropping of seedlings resulted. Oh! Oh! The author went out to the propagating shed, dug up the poor little teak seeds for the umteenth time, put them in the family popcorn popper, and shook them over a slow fire. Pop! Pop! went the seeds, like so many little firecrackers. Back into vermiculite they were plunged and 100 per cent germination resulted.'

Starting out with the idea of describing 500 species of beautiful flowering trees, the author found the material at hand so extensive as to require twice that number for adequate treatment. Even so, he thought it necessary to add a chapter about 'Flowering Trees That Were Left Out of the Book'.

Numerous trees with which we are familiar in India figure in the pages of this book, and it is pleasant to look at them through the eyes of a foreigner. They are not always the same in appearance and behaviour as they are in this country. I mention, for example, a Kanakchampa (*Pterospermum acerifolium*) in Orlando, Florida, planted about seventy-five years ago: 'Repeatedly frozen back to the ground, it has as repeatedly come back from the roots, so that today its dozen trunks still proudly support a leafy crown 30 feet or more in the air.' Also, the tree has never been known to set seed in Florida. Similarly, in Florida our stately Queen's Flower Tree (*Lagerstroemia speciosa*) is 'a great sprawling shrub that makes no effort to become treelike unless tied to a stake and forced up'.

There is much more of interest, but I think I have given enough samples to tempt my reader to go to the original for it. I must, however, give one more extract, which will explain for itself why I feel compelled to do so:

> 'What matters it whether the tree you plant grows in your own yard or in your neighbor's? All you can do anyway is feast your eyes on its beauty. You can probably see it better if it is planted in the yard across the street, than if it is crowded into your own place. Who owns the real estate where a thing of beauty stands is of small consequence. If there is no more room in your yard and you feel your job there is complete, it is time to start all over again. Plant a beautiful tree in your neighbor's yard, or in the city parkway, or in that ugly vacant lot next door.'

The text is enriched by 425 beautiful plates in full colour, mostly showing the flowers or the fruit, but including some, e.g. plates 378 and 379, showing the beauty of the tree as a whole. In addition, there are 40 line drawings by Eva Melady, drawn with meticulous care by an artist who evidently loves the work.

For the fare provided the price is not unreasonable.

There is one strange error to be corrected. Though the bibliography correctly mentions Blatter & Millard's SOME BEAUTIFUL INDIAN TREES as published by the Bombay Natural History Society, the text incorrectly says that it first appeared as a series of articles in *'The Bombay*

Journal of Botany'. The fact is that the authors of the book were valued members of the Bombay Natural History Society and the series of articles first appeared in the Society's *Journal*.

S.R.

2. THE HOUSE SPARROW. By J. D. Summers-Smith. pp. xvi+269 (13.5×20.0 cm.). With a colour frontispiece, 32 photographs in black and white, and 36 text-figures. London 1963 (Collins). Price 25*s*. net.

As a species the House Sparrow (*Passer domesticus*) is, at the present time, certainly one of the most ubiquitous birds, sharing with man an almost worldwide distribution. In Great Britain it ranks with the Chaffinch and the Blackbird as the most common and abundant resident species.

Despite its being such a regular commensal of man—making itself completely at home around his habitations, fields, and factories—surprisingly little precise information was available regarding its ecology and life-history. Over a period of 11 years the author studied the entire yearly cycle and every phase of House Sparrow activity in Great Britain with the aid of colour-ringed local populations in a rural as well as an urban-industrial environment. Pair formation, nest building, sexual and communal display, courtship, egg-laying, clutch size, incubation and nesting success, care of the young and their subsequent dispersal, enemies, mortality, sex ratio, and the behaviour patterns motivated by all these activities are some of the topics that form this fascinating record. He discusses the extreme adaptability of the House Sparrow as shown by its ability to thrive as a sedentary breeding bird—without recourse to seasonal migration—in countries with temperatures as divergent as −15° F. and 110° F., and at altitudes ranging from sea-level to 15,000 feet, and to profit from the liveable conditions which man has artificially created for himself in such inhospitable climes. Its bumptious aggressiveness combined with a natural wariness, and its catholicity in food and feeding habits have contributed in large measure to its phenomenal success as a colonist, whether by natural expansionism or by human introduction, in such far-flung ends of the earth as the Americas and Australasia. The history of its introduction into different parts of the world is very fully documented in Chapter 15—'Origins and Distribution'.

The communal displays known as 'Sparrow Weddings' or 'Sparrow Parties'—always an intriguing situation for the bird watcher— where a single female seemingly on the defensive is mobbed by a swelling circle of noisily strutting amorous cocks, is well described, and an explanation of its function is suggested.

It is found that house sparrows pair for life, but that, if one of the mated pair is accidentally killed or otherwise disappears, he or she is quickly replaced by another from an apparently ever-present 'waiting list,' or reservoir, of unmated birds of either sex. An instance is cited of seven cocks thus rapidly filling the vacancy caused by the shooting of one cock after another at a nest on which a female was incubating a clutch of eggs. Curiously enough this episode is almost identical in nearly every detail with an experience of the reviewer in India, recorded in the *Newsletter for Birdwatchers* for June 1962. Social behaviour, particularly concerning roosts and roosting in urban areas in Great Britain, seems to differ in certain respects from what has been casually observed in Indian birds (*P. d. indicus*) in Bombay City for example. The difference may be of degree rather than of kind, but nevertheless a comparative study of roosting habits under the more or less uniform tropical conditions prevailing here—without anything like a northern winter to interrupt the yearly rhythm—would be of great interest and may possibly disclose some adaptive significance. For instance there is no reference to a type of roost common in Bombay City, sited in moderate-sized leafy roadside trees, frequently in the heart of a bustling bazaar, where house sparrows—presumably from the immediate neighbourhood —gather noisily to sleep at sunset and depart near sunrise preceded by much twittering and chatter. Such roosts, strung out every few hundred yards along busy thoroughfares, seem to remain in use more or less the year round. In our area, moreover, the birds breed practically throughout the year with perhaps a slight slackening during the rainy season, June to September—a fact which may bear some correlation.

Young birds after fledging are said to wander between the various breeding colonies, but never more than a few miles. Once a nest site and mate have been acquired (the young breed when less than 12 months old) sedentary life begins and the house sparrow is reluctant to move across even a short stretch of unsuitable country. This extreme sedentariness accounts for the curiously patchy local occurrences of the bird and is doubtless the origin of the genetically different populations that have developed within the House Sparrow's circumglobal distribution.

Chapter 19 sums up the secret of the House Sparrow's success as a colonist. Among the chief ingredients are: catholicity of food and feeding habits, adaptability for commensalism with man in both town and country environments, and capacity for learning quickly and profiting from the experience of others of its kind how to avoid dangers and natural enemies such as cats, hawks, and occasionally even man. But the main reason for immediate colonising success where deliberately introduced by man seems to be that the bird is already conditioned to occupy an ecological niche that has not been exploited by any native species, namely human habitations, and therefore meets with no serious competition from 'vested interests'.

The book ends with six useful appendixes and a selected bibliography of 66 titles. Both the author and the publishers deserve congratulation on this admirable production which, incidentally, is No. 19 of the well-known monographs on British animals in 'The New Naturalist' series. The book is fascinating to read and well documented throughout. It provides a valuable reference source for comparative ethological studies on the house sparrow in other climatic regions of the world.

S.A.

3. A CLASSIFICATION OF LIVING ANIMALS. By Lord Rothschild. pp. vii+106 (26×17 cm.). Glasgow, 1961. Longmans Green & Co. Ltd. Price 25*s*.

This handy little book fulfils a long felt need in the study of the animal kingdom by providing a comprehensive, summarized, and up-to-date classification of animals, and should prove very useful not only to zoologists but also to students of allied disciplines.

The scope of the book is best explained in the author's words: 'The book and its index can be used to find out how the animal kingdom, or parts of it, are classified, which are the eutherian mammals, what phasmids and Homoptera are, etc. Neither the book nor its index can necessarily provide answers to questions about the systematic positions of individual genera, because there are some two hundred thousand genera in the animal kingdom.' Chapter I explains the purpose of the book and how to use it. Chapter II is a summarized classification of living animals. Chapter III is a classification of living animals, with examples of genera in each class, order, sub-order, etc. Appendix 1 provides references for further reading. Appendix II is a list of the authorities consulted on the classifications.

One hopes that the book will not be 'dated' within a few years for systematics is a field in which stability is noted in very few of animal groups, new finds and new methods of approach and outlook frequently up-setting apparently established arrangements. For instance the present publication offers alternative classifications for three groups and the author notes that alternative classifications are available for several more. Indian zoologists who are not systematists and who graduated a decade ago will be surprised at the changes that have since occurred in Systematic Zoology.

J.C.D.

4. A BIRD AND ITS BUSH. By Michael Lister. pp. 142 (22×14.5 cm.). With 35 photographs and 16 text-figures. London, 1962. Phoenix House Ltd. Price 16*s*. net.

The first stage in the scientific study of birds has been the collecting of specimens in the field and taxonomy in the museum. In most parts of the world, the bulk of the taxonomic work has been completed and ornithologists are exploring various aspects of ecological and other studies both in the field and in the laboratories. Indian ornithology is still in its infancy and our few field workers have not yet provided the preliminary background of knowledge to facilitate more detailed studies of the finer problems of ecology.

This little book tries to create the background for English conditions. The 'Bush' described in 8 chapters includes geology, soils and topography, climate and weather, vegetation, as well as other inhabitants of the area. Such a book is badly needed in India to enable the birdwatcher to identify and name the many factors which make up a habitat. A rose by any other name may be the same, but restriction to one definite name is essential to permit its study. The worker must be able to give a name to the phenomenon, plant, or other object with which his observation is associated. Alternatively, without such knowledge, he cannot record it suitably nor benefit by the information already recorded by others.

While we may not have a birdwatcher with the supplementary knowledge required for such a book, it may be possible to produce it collectively. It would certainly be of great assistance to all concerned.

H.A.

5. BIRD. By Lois and Louis Darling. pp. xi+261 (23×15.4 cm.). London, 1962. Methuen & Co. Ltd. Price 30*s*.

This husband-and-wife team of ornithologists set themselves a very ambitious task—nothing less than 'a basic, simplified but scientifically valid account of evolution, behaviour, anatomy, and physiology of birds as well as comparison of these features with those of the animals'. It was not a modest target and one would be justified in being sceptical about the competence of anyone to fulfil a task so comprehensive. But after reading the book one concedes that it is an undoubted success. In spite of being filled with detail the book can be read effortlessly throughout. For this, a great deal of the credit must go to Mrs. Darling whose superb illustrations help to illuminate and clarify all the more difficult portions of the text. In his foreword Niko Tinbergen says: '. . . the authors had a strong urge to communicate. They have kindled the fire of motivation . . . they delight in detail, but the results of scientific analysis are continually put back into their proper functional context.' The great merit of the book is the sense of proportion with which it has been written; we never lose sight of the wood for the trees.

The book consists of three main parts: Time and Birds, Behaviour, and Anatomy and Physiology. As may be imagined the first two sections are the more absorbing ones for the general reader.

The initial chapters on Evolution refer to the highlights in man's discovery of the process. A glance at a neat tabulation of Eras, Periods, and Epochs helps to assess the geologic time, e.g. that birds arrived in the world in the Jurassic period of the Mesozoic era, that is 165 million years ago—man it may be recalled is only one million years old. The fossil Archaeopteryx, the first creature that can be called a bird, was found in Bavaria in 1861. The authors point out, with the help of a striking sketch, that the most fortunate feature of the fossil was the imprint of the feathers embedded in the limestone. Without this clue it may have appeared that the fossil belonged to a reptile and studies in bird evolution would not have progressed as rapidly as they did. In 1872 the discovery of the fossil of the sea-bird Hesperornis was another valuable guide post, and then scientists could confidently assert that by the time of the Eocene epoch, 60 million years ago, there were already fifteen orders of birds in existence as against 28 at present. Immediately Man arrived on the scene he started to take an interest in birds, as pre-historic cave drawings and engravings show. Unfortunately his contact with birds has not always been to the advantage of the latter.

Darwin's visit to the Galapagos Islands in 1835 on the equator, 600 miles to the west of South America, was an event of decisive importance to the progress of evolutionary studies. In these islands, cut off from the mainland, the effects of the forces of Natural Selection and Survival of the Fittest could be clearly seen. From a single ancestral seed-eating ground finch fourteen other types developed. The bill of each species was a pointer to the type of food it ate and the habitat which it preferred. At this stage the authors emphasise a point which is not quite obvious to a layman; that hereditary changes always come first, and adaptation to the environment follows. For instance, ducks started with normal feet, not with webbed toes perfected for swimming. Webs were developed from fortuitous natural variations in the direction of webbed feet, giving a slight advantage, or survival value, in swimming and food-getting to the possessors over other birds without them. Thus, by working upon and improving the minor variations, Natural Selection gradually eliminated the less fitted in the struggle for existence, and perfected the webbed feet of ducks and other specially adapted swimming birds seen today.

The chapters on Behaviour are written with a sureness which could only be shown by persons who have the knack of handling birds and maintaining the most intimate relations with them. The authors frequently 'imprinted' themselves on the minds of young birds, and occasionally goslings and ducklings preferred their companionship to that of the natural parents.

It is a rule of thumb that if a species has an outstanding brightly coloured mark it will be used in display. The authors refer to the interesting fact that closely related birds which have overlapping breeding ranges have distinct colour insignia or behaviour patterns of their own. Mallard, Pintail, and Widgeon, for instance, should have little difficulty in recognizing one another, and a female mallard could offer no legitimate excuse for flirting with a male widgeon. But birds whose breeding ranges are separate, like the Black Duck and the Mottled Duck, can afford to look the same without endangering racial purity.

Describing the flight mechanism of birds is a difficult matter. Some writers treat the subject so technically that one forgets that birds are involved in it. Some simplify it to such an extent that there seems nothing to it except the simple fact that speed increases lift and vice versa. The Darlings, because of their ability to relate details to their functional context and with the assistance of lively sketches, give the reader a feeling of knowing a lot more than he did before. If only for this, the book is well worth possessing.

Z.F.

Miscellaneous Notes

1. ON THE CRANIAL CHARACTERS OF *MACACA SILENUS* (LINN.) (PRIMATES : CERCOPITHECIDAE)

(*With a plate*)

The specific differences in the cranial characters of catarrhine monkeys are not conspicuous and are often masked by individual variations. This caused many earlier workers to rely more on external characters and devote less attention to cranial variations. In many cases the published accounts of specific cranial characters are not based on a sufficiently good series of specimens to sift out the individual variations. Of the Indian species of the genus *Macaca* (Primates : Cercopithecidae), the least known in this respect is *M. silenus* (Linn.), the Liontailed Macaque of the Western Ghats of India. The only known descriptions of the cranial characters of this species are those of Anderson (1879) and Pocock (1939). Elliot (1912) records only the measurements of a skull. Anderson's description of the skull, based on a single male specimen, is extremely general and vague. The features described by him are either common or individual, none being characteristic of the species. Pocock, having only an incomplete skull, relied for the most part on Anderson's description, adding as far as the broken specimen would permit some of his own observations. The sulky, savage nature of this monkey and its inaccessible forest abode make it difficult to procure material and there is a paucity of skulls in many zoological collections. The present detailed description of the cranial characters of this species is based on a series of five specimens (2 ♂♂ and 3 ♀♀). In addition, four adolescent skulls were examined to study the lines of cranial development. I wish, in this connection, to express my sincere thanks to the Bombay Natural History Society who kindly spared two specimens for my examination.

DESCRIPTION

The brow-ridge is well developed and curved backwards acutely. The temporal ridges start from the two sides of the brow-ridge and join the occipital crest separately, although in one skull they are very close together at this confluence. In female skulls the temporal ridges are very faint and never converge posteriorly. The occipital ridge in the male is well developed, especially at the mastoid region. The orbital ring and the inter-orbital septum are more vertical and steeply curved than in allied species. In adult male skulls the maximum width of the orbital margin, which is across the lowermost point of the vertical wall of the orbit (jugal), is slightly greater than the mastoid width.

The jaws are fairly long, but not as long as in *M. nemestrina* (Linn.). The anterior zygomatic root is directly in a line running vertically in between the second and the third molars. In short-jawed forms the corresponding line will be through the second molar. The post-canine depression on the sides of the muzzle is prominent and extends upwards along the ascending process of the maxilla up to the base of the inter-orbital septum. The nasal and the ascending process of the maxilla tend to be slightly raised above the general level of the maxilla, so that this part often forms a distinct table on the muzzle.

Ventrally, the pterygoids curve outwards symmetrically so that the mesopterygoid fossa is narrowest in the middle. The posterior palatine foramina are situated anterior to, or in line with, the third or last molar, never posterior to it, which again is an indication of jaw length. The transbullar width is markedly less than the mastoid width, as the external auditory meatus does not extend up to the fringe of the squamosal. This feature is more marked in female skulls.

The measurements of the specimens examined by me are noted in the table on page 248.

DIFFERENCES IN CRANIAL CHARACTERS BETWEEN THE SEXES

Certain differences between the sexes in cranial characters are particularly striking. Many of them may be common to the genus, but as this aspect has not been discussed much in this genus, it may be worth recording them here. The most obvious is the marked difference in size, the female skull being much smaller. On the whole, the female skull shows less muscular development, the various crests that are present in the males are often absent or feebly developed in the female. Generally, it can be said that the female skull retains the juvenile condition in its cranio-muscular relations. The transbullar width is less than the mastoid width by a greater

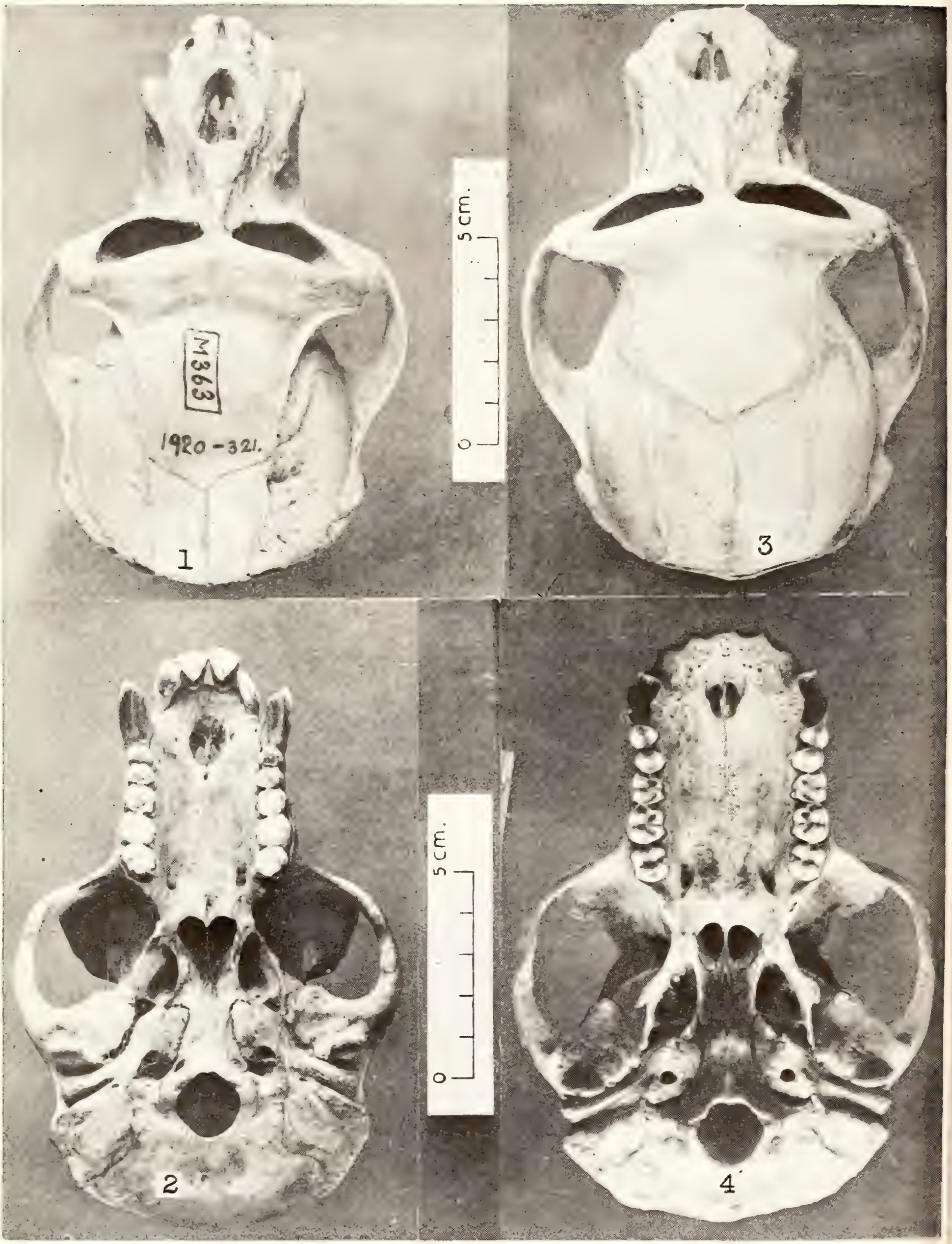
TABLE

CRANIAL MEASUREMENTS (IN MM.) OF *MACACA SILENUS* (LINN.)

Reg. No.	Sex	Total length	Condylo basal length	Facial-axis length	Palatal length	Cheek teeth row length	Bulla length	Zygomatic width	Mastoid width	Transbullar width	Maxilla width at canines	Inter-orbital septum thickness	Mandibular length	Lower cheek teeth length
7752	Female	103.2	77	44.3	38	28	25.5	73.2	59.2	51.5	26	3.8	69	31.7
7753	Female	106.2	80.4	48.2	43.2	28	26.5	72	62.2	54	26.3	3.3	69	33
7750	Female	107.7	80	50	42.6	28.2	25.6	73.2	61.2	53.5	26	4	69	29
M10 B.N.H.S.	Male*	127	103	68	58	31.2	31.8	87.4	71	62.4	36.4	6.2	89.5	48.7
M363 B.N.H.S.	Male	135	107	69.6	62	33.2	35.6	93.3	76.2	69.8	38	6.8	90.7	40.1

* This skull is unsexed, but is obviously male

1. *Facial-axis length:* Taken from the anterior end of the muzzle to the maxillo-spheniod suture in the meso-pterygoid fossa.
2. *Transbullar width:* Transverse distance between the extremities of the external auditory meatuses.
3. *Mandibular length:* Maximum length at the alveolar line.


1
2
3
4
M363
1920-321.
5 cm.
0
5 cm.
0

Figures 1 & 2 : dorsal and ventral views of skull of *M. silenus* (♂) ; Figures 3 & 4 : dorsal and ventral views of skull of *M. nemestrina* (♂).

degree in females. The facial length is also proportionately less and, owing to the smaller size of the canines, the muzzle is more tapering in front. The measurements indicate that the difference between the upper and lower cheek teeth is proportionately more in males than in females. The orbital margin width is lesser than the mastoid width in female skulls because of the inflated condition of the latter and the lesser development or bulging of the orbital ring.

COMPARISON WITH ALLIED *M. NEMESTRINA*, (LINN.)

Macaca silenus	*Macaca nemestrina*
1. Post-canine depression on the muzzle extends along the ascending process of the maxilla up to the base of inter-orbital septum.	1. Post canine depression on the muzzle extends only up to the mid-lateral line.
2. Nasal bone region elevated above near-by areas of the maxilla	2. Nasal bone region flat
3. The pterygoid bones are evenly curved outwards so that the narrowest part of the meso-pterygoid fossa is in the middle.	3. The pterygoid bones are straight and closer to each other posteriorly so that the narrowest part of the meso-pterygoid fossa is on its posterior end.
4. The posterior palatine foramina are situated either anterior to, or in line with, the last molar.	4. The posterior palatine foramina are posterior to the last molar.
5. Size smaller	5. Size larger

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM,
CALCUTTA, 13,
January 14, 1963.

G. U. KURUP
Asst. Zoologist (*Mammals*)

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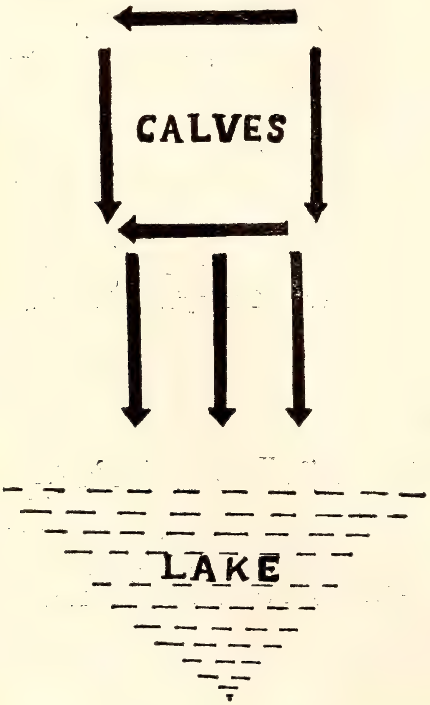
2. A CURIOUS PROTECTIVE DEVICE AMONG WILD ELEPHANTS[1]

(*With a text-figure*)

Recently, I had an opportunity of making a faunistic survey at Thekkady (Kerala State) on the bank of Periyar Lake. The lake is an artificial one, formed out of the impounded waters of the Periyar River for irrigating the Vaigai Valley in Madras State. Part of the original forest on the hillocks on the way is submerged by the diverted river water and, in the midst of the lake, we can see isolated hillocks and, on them, remnant strips of the forest. The Kerala Government has established a game sanctuary for wild elephants at this beautiful place.

On 23-3-1962, our party proceeded to Periyar head-water works. On the way, we noticed 23 wild elephants (all cows) feeding on the grass on an isolated hillock. One of us started taking a movie from our boat, when we were still some distance from the shore. Probably disturbed by the sound of the motor boat and of the movie camera, one of the elephants gave a loud trumpet call. Immediately, another batch of 14 elephants, which included one old tusker, two smaller tuskers, and five calves, came running. This new batch obviously belonged to the same herd, since they mingled freely with the old batch. Three of them, including the one which trumpeted, stood facing the boat. Four cows formed square behind them (see text-figure, in which the arrowheads represent the heads of the elephants), and two calves were driven into the square. A similar square was formed for the other three calves. Both the squares were closely packed. This phenomenon is obviously a curious protective device for the young. Some of the elephants led by the old tusker



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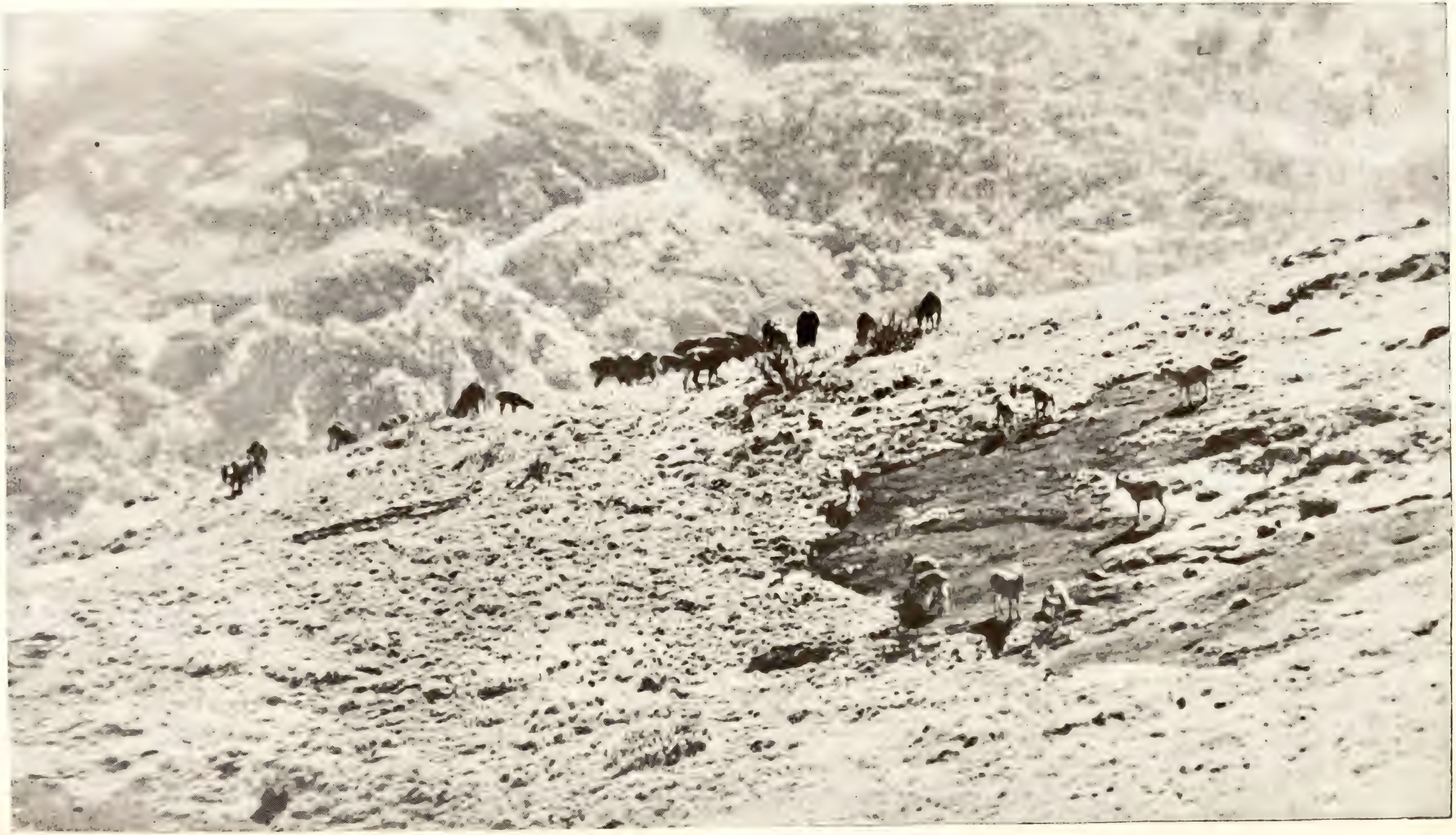
[1] Communicated by Dr. K. K. Tiwari, Zoological Survey of India, Calcutta 13.



Section of the large herd of Nilgiri Tahr started moving towards the water's edge at an angle (following the usual route through which they enter the lake), probably to charge us in case of need.

The boatmen stopped the engine, and prepared to row away lest the elephants charge us. We stopped taking the movie and waited for a while. The elephants then calmed down, and the two small tuskers even started a mock fight.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA 12,
December 12, 1962.

K. V. LAKSHMINARAYANA

[Mr. E. O. Shebbeare, I.F.S. (Retd.) to whom this note was sent for opinion comments: 'I have never seen a wild herd behave at all as your correspondent tells us the Periya one did, but there is no reason why elephant behaviour should be the same throughout Asia: for example reports have been published that, in S. India, a herd is sometimes led by a bull--a thing I have never come across. My experience with wild elephants has been restricted almost entirely to N. Bengal, Assam, and Chittagong except for a few years as a game-warden in Malaya.'—EDS.]

3. CENSUS OF THE NILGIRI TAHR *HEMITRAGUS HYLOCRIUS* (OGILBY) IN THE NILGIRIS

(*With a plate*)

A census of the Nilgiri Tahr *Hemitragus hylocrius* (Ogilby) (locally known as the Ibex) on the Nilgiri Plateau was taken at the end of January 1963. The tahr country was divided into four blocks and four parties did a simultaneous count in them. Every precaution was taken to avoid duplication. The tahr live among the cliffs and, if undisturbed, come up during the day to feed on grass on the mountain tops. Therefore, the visual method of counting is most suitable and was adopted. Binoculars and telescopes were used as aids. The tahr actually seen and counted amounted to 292. On a very conservative estimate, at least a third of this number escaped observation on account of unfavourable ground, wind, and weather conditions. So it can be safely estimated that there are about 400 tahr in the Nilgiris and their number appears to be registering an increase.

The largest herd consisted of 38 animals. Several fine saddle-backs and brown bucks were seen, also a number of young tahr. Although the herds move from area to area the places where the saddle-backs were found are not given for obvious reasons.

The herd on the eastern slopes around Glen Morgan has been wiped out by poachers, thanks to the ban imposed on shooting and the consequent absence of licence holders who provide a check on illegal shooting. No tahr were seen in the Nilgiri Peak area and it is reported that this is because of poaching by the estate labour. Licence holders will be doing a great service by frequenting this area.

In the Kundah Hydro-Electric Scheme area roads are being laid in the tahr country and forest wattle plantations are also being pushed through. Poaching activity is therefore expected to increase. This seems a crucial stage in the protection of this species.

In conclusion I may state that unless the licence holder is allowed to pursue the saddle-backs, most of which are useless for breeding purposes, and thus patrol the area, there is no doubt that tahr will eventually share the fate of the Glen Morgan herd.

THE NILGIRI WILD LIFE ASSOCIATION,
OOTACAMUND,
NILGIRIS, SOUTH INDIA,
February 14, 1963.

E. R. C. DAVIDAR,
Honorary Superintendent

[Leslie Brown in a note entitled 'Wild Life in some areas of South India', published in Vol. **57** (2) : 403-408, 1960, of our *Journal*, at p. 404, says: 'In the Nilgiris, on the high plateau sambar were few, but I saw without difficulty a herd of 16 Nilgiri Tahr.'—EDS.]

4. STRANDING OF A BLUE WHALE *BALAENOPTERA MUSCULUS* (LINN.) NEAR SURAT, GUJARAT, WITH NOTES ON EARLIER LITERATURE

On press reports of the stranding of a whale, which were confirmed by the local Superintendent of Fisheries, an assistant of the Society, Shri V. C. Ambedkar, was sent to collect data. The whale was stranded on 23 February 1963 close to village Gavier, near Magdalla Port, about seven miles from Surat. On 27 February when the body was examined, decomposition had progressed considerably and the skin had almost completely peeled off. A patch of skin still on the body near the flipper was slate-grey in colour. Some portions of the floor of the mouth were dirty yellow. The following measurements were obtained:

Total length	20.28 m. (66 ft. 6 in.)
Length of flipper	3.30 m. (10 ft. 10 in.)
Upper jaw	5.60 m. (18 ft. 4 in.)
Lower jaw	4.10 m. (13 ft. 5 in.)

Among species of *Balaenoptera*, the Blue Whale [*Balaenoptera musculus* (Linn.)] has the longest flipper, approximately 1/7th of the body length as against 1/9th or lower in other species of the genus. The length of the animal and ratio of the length of its flipper to its total length establish the identity of the specimen as *B. musculus*. In the Fin Whale [*Balaenoptera physalus* (Linn.)], the only other species of the genus which grows to over 60 ft. in total length, the ratio is 1/9th; the average of its total length is also less than that of *B. musculus* being 63 ft. male, 65 ft. female as against 74 ft. male and 77 ft. female (Gibson-Hill, 1950). The present specimen is apparently immature. This species is referred to a distinct genus *Sibbaldus* in American classifications, a position that has not been accepted by Ellerman & Morrison-Scott (1951) and most other European authors.

It might be of interest to mention some points arising out of the literature on the stranding of whales on the coasts of India. Gibson-Hill (loc. cit.) has commented on the probable species of the strandings recorded in S. T. Moses's (1947) list of whales stranded on the coasts of India and in near-by areas. He has, however, overlooked the specimen from Naduvattum, Kerala, in the list, first reported by P. K. Jacob & Devidas Menon (1947), the length (45 ft.), colour, and number of ventral furrows (45) of which agree with his description of the Sei Whale, *Balaenoptera borealis* Linn., and which was probably of this species. Ellerman & Morrison-Scott (1951) give its distribution in the tropics as Borneo, Java, and Siam.

One very interesting fact noted by Jacob & Menon (loc. cit.) is that the animal had fed on a large shoal of mackerel (*Rastrelliger kanagurta*)—the usual food of this species in the North Atlantic is a tiny crustacean *Calanus finmarchicus*. In this connection, the popular name of the species in Norway and Japan may not be without significance. The Norwegian 'Seievhal' seems to comment on the arrival of the whale in Norwegian coastal waters when the Sei or coalfish (*Gadus virens*) are migrating; and the Japanese name 'Iwashi-Kujira' is translated as 'Sardine Whale'. There is, however, little evidence to prove that the names are in fact associated with the food habits of the animal. Shoals of mackerel occur along the west coast of India in January, the month of the stranding at Naduvattam. Feeding on fish is not peculiar to *B. borealis*, for the Fin Whale [*B. physalus* (Linn.)] is known to feed on herring and other fish, particularly *Osmerus arcticus* (Sanderson, 1958).

Since Gibson-Hill's (1950) note on Rorquals there has been one additional report in the *Journal* on the stranding of a whale (V. K. Chari, 1951). The species is recorded as *Balaenoptera indica* Blyth [=*Balaenoptera musculus* (Linn.)] but the measurements noted (total length 68 ft., flipper 6 ft. 1 in.) show a rather short flipper for *B. musculus* and the possibility that the whale was *Balaenoptera physalus* (Linn.) cannot be overlooked.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6-WB.,
April 8, 1963.

J. C. DANIEL,
Curator

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5. 'TRANSMISSION OF RABIES WITHOUT BITING'

With reference to our Miscellaneous Note in the April 1962, Vol. **59** (1), number of the *Journal* on the transmission of rabies by a non-bite route, Dr. Alan Gilroy, Principal, Ross Institute of Tropical Hygiene, India Branch, Assam, has drawn our attention to an announcement by Dr. G. Stuart in the *Tropical Diseases Bulletin*, Vol. **59**, No. 8, p. 776, August 1962, London, referring to a paper published in Prague [Yurkovsky, A. M. (1962): Hydrophobia following the Bite of Apparently Healthy Dogs. *J. Hyg., Epidemiol.,* *Microbiol. & Immunol.* v. 6, No. 1, 73-8, (13 refs.), Prague 1962]. Dr. Stuart, himself a specialist in rabies, writes:

'An analysis of reports from Pasteur Institutes in the U.S.S.R. reveals that since 1947, in different republics or regions in the territory, there have been 21 cases of hydrophobia in persons bitten by apparently healthy dogs. In these cases, in which the length of the incubation period varied from 1 month to 2 years, diagnosis was based mainly on the typical clinical picture presented, but in 5 of 6 on whom a post-mortem examination was carried out Negri bodies were found to be present in the brain. Reports on the 21 dogs responsible for the biting showed all to have remained clinically healthy after their victims had developed rabies.

'These findings confirm the view previously expressed by many authors that apparently healthy dogs may act as carriers and transmitters of the rabies virus and that risk of infection is not, therefore, limited to contact with a clinically rabid animal which develops rabies within 14 days after the time of biting.

'Inasmuch as apparently healthy carriers as well as clinically rabid animals secrete the rabies virus in their saliva, the author stresses the importance of examining the salivary gland to determine the degree of danger of an animal bite. In this connexion it is noteworthy that, in the opinion of some workers, absence of virus from the saliva, even when it is present in the brain, provides sufficient reason for withholding specific treatment. 5 case histories are given. (See this *Bulletin*, 1958, v. 55, 30.)'[1]

We may add that all specialists do not accept these findings as conclusive. For instance, Dr. A. N. D. Nanavati, Assistant Director, Department of Virology, Haffkine Institute, Bombay, who was asked for his opinion writes:

'May I point out that your note "Transmission of rabies without biting" is likely to give rise to the impression (though you have not said so) that all the bat species mentioned are capable of causing rabies without biting and may be responsible for indiscriminate bat-slaughter by readers of the *Journal* unless you clarify this point!! *The Frio Cave incident is the only known instance* of such infection occurring. Various explanations for this are possible, or it may turn out to be inexplicable, but it still needs a lot of investigation.

'The known information on rabies can be summed up as follows:

'1. Rabies can occur in an individual (human or animal) who comes into contact with saliva or raw flesh of a rabid animal, i.e. the infecting animal, even if symptom free at the time, must die of rabies, usually within 10 days. (The only known exception to this is the vampire bat which is reported to be an immune carrier. No other bats have been found immune so far.)

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[1] We are grateful to the Editor of the *Tropical Diseases Bulletin* for permitting us to reproduce this extract.—Eds.

'2. The rabies virus (infection) cannot penetrate through unbroken skin. The infecting saliva must, therefore, come in contact with a break in the skin (as in biting) or with the mucous membranes (conjunctiva, mouth, etc.).

'The reference mentioned by you is an abstract of a recent WHO report discussing about 21 cases, and mentioning others, where rabies is said to have been caused by contact with *non-rabid* dogs. Since all the necessary data are not available one does not know what to make of these reports. Such transmission can only be proved by showing the presence of infective virus in the animal's saliva, which has never so far been done. Contacts with dogs are very common, (the only incidents recalled later being ones of actual biting etc.) and it is very likely that the actual infecting contact, if a minor scratch, or a lick over a cut or abrasion on the skin, may have passed unnoticed. I would not rule out the WHO reports completely, but would be very chary of accepting any such incident without the positive evidence of virus in the saliva. This is very difficult to provide, since suspicion is not aroused until long after the incident, when symptoms start appearing.'

As we would not like to be responsible for a holocaust of bats in India we are glad to publish Dr. Nanavati's observations. Incidentally, the genus *Tadarida* to which *T. brasiliensis mexicana* Saussure found in the Frio Cave belongs, occurs in India, but not this particular species; nor have we any species of vampire bats (*Desmodus*).

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD, EDITORS
BOMBAY 6-WB.,
February 16, 1963.

6. SOME RECORDS OF PETRELS HANDLED IN THE NORTHERN INDIAN OCEAN

Although H. G. Alexander (1929, 1931) and W. W. A. Phillips (1947, 1950, 1954, 1955) and numerous subsequent authors have reported that many petrels can sometimes be seen in the northern

Indian Ocean, few of these birds have ever been examined in the hand. The most important evidence for the identity of the birds seen at sea therefore rests on reviews of birds collected on ships by Junge (1941), of the large dark petrels by Jouanin (1955, 1957), and of the 'Persian' Shearwater *Puffinus lherminieri persicus* by Phillips & Sims (1958). Although it is well known that Wilson's Storm Petrel *Oceanites oceanicus* winters in this area (Roberts 1940), and Junge reported the collection of a number of moulting Whitefaced Storm Petrels of the Australian race *Pelagodroma marina dulciae* all round the northern border of the Indian Ocean during the southern winter, the only evidence for the identity of another species in the area has previously been a specimen of the Blackbellied Storm Petrel *Fregetta tropica* labelled 'Bay of Bengal' in the Tweeddale collection in the British Museum (Gibson-Hill 1948).

During the course of a cruise through the Indian Ocean in an aircraft carrier in 1960 the first author saw numerous petrels come to the deck-lights at night, and was able to handle some, including a Blackbellied Storm Petrel. Photographs of two of the larger petrels handled have already been published in the journal of the Royal Naval Bird Watching Society, *Sea Swallow*, for 1960, together with an account of the petrels of the area by the second author, and many other observations of the seabirds of the area will be found there; since the Blackbellied Storm Petrel is the first which has actually been handled in recent times in the Indian Ocean north of the equator, it seems desirable to call attention to this record in particular here.

THE BLACKBELLIED STORM PETREL

A bird came to the deck-lights at night at 08° 03′ N., 72° 50′ E., 14 miles SE. of Minicoy, on 9 September 1960. The head, neck, upperparts, wings, tail, bill, and legs were more or less black, the rump, belly, flanks, and under tail coverts were white, the underwing was grey, and there was a dark line down the centre of the belly. The overall length was 180 mm., the overall wingspan 410 mm., the wing 168 mm., the tail 70 mm. and almost square, the exposed culmen was 15 mm., the tarsus 40 mm., and the middle toe 28 mm. The account agrees exactly with the more southerly populations of *Fregetta tropica* which breed to the south on Kerguelen among other subantarctic islands. Numerous sight records of storm petrels of the genus *Fregetta* by Phillips (1947) and a number of subsequent observers suggest that this species is a common visitor to the central Arabian

Sea during the southern winter, arriving about May and leaving about September. The very similar Whitebellied Storm Petrel *Fregetta grallaria* may occur as well, but we are not aware that one has been handled yet.

OTHER SPECIES

A Whitefaced Storm Petrel *Pelagodroma marina* came on board and was photographed in much the same area as the last species earlier in the year, at 08° 05′ N., 73° 00′ E. on 28 May.

Examples of *Bulweria* (*bulwerii*) *fallax*, recently described by Jouanin (1955), came on board at 16° 40′ N., 55° 15′ E. and 18° 50′ N., 57° 50′ E. on 14 February, and 11° 24′ N., 57° 05′ E. on 25 May in the central Arabian Sea off the mouth of the Gulf of Aden. They agreed in appearance with the original description, except that one was said to have a paler chin. The overall length in life was 295-300 mm., the overall wingspan 790 mm. The local water temperature was 78° F. in February, and 83° F. in May. The third bird vomited a small squid about 2 cm. long. The Indian specimen of the Mascarene Petrel *Pterodroma aterrima*[1] quoted by Ripley (1961) should perhaps be re-examined to see if it is this species.

Wedgetailed Shearwaters *Puffinus pacificus* came on board at 09° 25′ N., 66° 24′ E. on 27 May and at 05° 10′ N., 84° 00′ E. on 1 June. The bill was described as steel-grey with the tip black in the first case, and black in the second; the legs and feet were pink. The overall length in life was 370-380 mm. (15 in.), the overall wingspan 860 mm. The water temperature was 83° F. in both cases, and the first bird also vomited squid.

THE GREEN, N. BAILEY
RAVENSTHORPE, NORTHANTS.,
ENGLAND.
46, WILBURY ROAD, W. R. P. BOURNE
HOVE 3, SUSSEX,
ENGLAND,
November 24, 1962.

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[1] The specimen of *Pterodroma aterrima* first reported by Sálim Ali & Humayun Abdulali in *J. Bombay nat. Hist. Soc.* **42** : 193, and later listed by Ripley in A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN (p. 5) cannot now be traced.—EDS.

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7. THE BLUETAILED BEE-EATER *MEROPS PHILIPPINUS* LINNAEUS, NESTING IN CEYLON

You will be interested to hear that I have recently established that the Bluetailed Bee-eater, *Merops philippinus* Linnaeus, nests in Ceylon.

I found a single pair at Kumana, in the Eastern Province, nesting in a sandy slope leading down to an estuary, during Easter 1962. I think that these birds were incubating as I saw one of the birds enter the hole and stay within for about 3 minutes only possibly feeding the mate. If young were being fed the visits would have been more frequent and regular.

Again, a fortnight later, I came upon some of these birds further north up the same coast obviously feeding young. They were catching flies over the sea and returning very regularly to the nest at intervals of about 5 minutes. Unfortunately, I could not get to where they had their nests as this was on the other side of a river over which I had no means of crossing.

PINGARAWA,
NAMUNUKULA,
CEYLON,
May 19, 1962.

C. E. NORRIS

8. THE COMMON HAWK-CUCKOO (*CUCULUS VARIUS VARIUS* VAHL) IN THE PUNJAB

When in 1930 Stuart Baker (FAUNA OF BRITISH INDIA, Birds **4**: 149) excluded the Punjab from the range of the Common Hawk-Cuckoo it had long been known to occur in several Punjab districts. Whistler (*J. Bombay nat. Hist. Soc.* **26** : 177, 287, 592) found it common in Ambala in 1916 and in Ludhiana in 1917, and in 1918 recorded it from Lahore. In Kangra in 1921-1923 he met with it each year in small numbers along the Kangra Valley up to about 4000 feet (*Ibis,* 1926,: 749). In 1933-1935 I myself found it common in Ambala and also collected specimens in the adjoining districts of Hoshiarpur and Karnal. In 1923 I took one at about 3000 feet in the Rawalpindi District in June and in the following month another at Jhelum, where several were haunting the Cantonment. From 1949 to 1954 I was stationed at Sargodha, the headquarters of the Shahpur District. There I repeatedly heard its call in the first half of June 1949, from the middle of March to the middle of July in 1950, and in the first half of August 1951. I have, however, no record of having heard it in the three following years. In 1960 I met with it for the first time in the Salt Range, which I had been frequently visiting for over forty years. On 11th and 12th March it was heard calling all day at Choa Saidan Shah (*c.* 2000 ft.) in the Jhelum portion of the Range, and a fortnight later at Sodhi, in the Shahpur portion, some 40 miles further west. It will be interesting to see how much further, if at all, it extends its range in this direction.

KALABAGH,
MIANWALI DISTRICT,
WEST PAKISTAN,
February 16, 1963.

H.W. WAITE

[Ripley in A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN (p. 176) gives the distribution of *C. v. varius* as: 'Breeds throughout most of India at lower altitudes than the preceding species (*Cuculus sparverioïdes*). A straggler in Rajasthan. Occurs east to Assam and East Pakistan, from the plains to 3000 feet; in open scrub land, light forest, and near cultivation.'—EDS.]

9. THE FOREST WAGTAIL *MOTACILLA INDICA* GMELIN IN THE GIR FOREST, SAURASHTRA

Recently I went to the Gir forest and while walking in a nullah where a stream was flowing I came across a Forest Wagtail, (*Motacilla indica* Gmelin) which flew away on seeing me, and I could distinctly see the white barring on the wings. This is the first time I have seen this bird in the Gir forest and perhaps constitutes a first record. In A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN (p. 574) the bird is mentioned as 'a straggler on passage in Gujarat (rare)' and later said to 'winter in India from Saurashtra (Junagadh), Surat Dangs . . . and southwards'. I do not know on what basis it is said to occur in Saurashtra.

DIL BAHAR,
BHAVNAGAR, R. S. DHARMAKUMARSINHJI
December 20, 1962.

[Sálim Ali (*J. Bombay nat. Hist. Soc.* **52** : 779) obtained it in the Surat Dangs and said 'not observed elsewhere in that area, but possibly occurs in the Gir forest of Junagadh (Saurashtra)'. We were unable to trace any other published record in support of Dr. Ripley's statement, and Dr. Ripley also could not recall whence he had obtained this information, but thought it may have been based on a specimen collected by Dr. Walter Koelz. Inquiry at the American Museum of Natural History, New York, Chicago Natural History Museum, Chicago, Illinois, and Museum of Zoology, University of Michigan, where most of the Koelz collection is housed reveals no specimen (of this species) from Saurashtra, and it is possible that Dr. Ripley misquoted Sálim Ali and that the present is the first record from that area.—EDS.]

10. FIRST RECORD OF BEDDOME'S WOLF-SNAKE *LYCODON TRAVANCORICUS* (BEDDOME), FROM THE LACCADIVE ARCHIPELAGO

A juvenile specimen of the Wolf-Snake *Lycodon travancoricus* (Beddome), measuring 199 mm. in length, was captured during March 1962 by student-members of a Social Service League Camp engaged in the construction of a road at Androth (Long. 73° 57′ E., Lat. 10° 48′ N.), and was handed over to me later by P. Gopinathan Nambiar, now Headmaster of the Government High School, Ameni Island, Though rare, it is well known to the natives of Androth who call it *Chera* [*Malayalam* name on the mainland for *Ptyas mucosus* (Linn.)] and what is interesting is that they refuse to consider this reptile as a snake at all! In Kerala this snake is called *Cheralav*, because of its superficial resemblance to *Ptyas mucosus* (Linn.).

Of the ten inhabited islands in the Laccadive group, Androth lies closest to the Indian peninsula, the distance to Calicut being only 139 miles. Inhabitants of no other island except Androth remember having ever come across a snake. The proximity of Androth to the mainland would suggest transportation as an easy possibility for the occurrence of the species in the island, and the collection of a juvenile indicates that the species is probably now breeding on the island. No other species of snake is known from the Laccadives.

Lepidosis

Costals at mid-body	..	17
Ventrals	..	185
Caudals	..	67
Anal	..	1

ACKNOWLEDGEMENT

The author is indebted to Miss Jennifer A. Cochrane of the British Museum (Natural History) for her help in lepidosis and identification of the specimen.

DEPARTMENT OF ZOOLOGY,
ST. JOSEPH'S COLLEGE,
DEVAGIRI, KOZHIKODE-8,
KERALA STATE,
September 23, 1962.

K. G. ADIYODI

[It is interesting to note that A. O. Hume in his article 'The Laccadives and the West Coast', *Stray Feathers*, Vol. IV, pp. 413-459, 1876, states that to control the rat population of the inhabited islands of the Archipelago 'Government sent down a lot of snakes and mongooses; the former, the people exterminated as undesirable colonists'. Perhaps the extermination was not complete and the specimen collected is a descendant of the ones that got away.—EDS.]

11. THE DIET OF THE INDIAN BULL FROG *RANA TIGERINA* (DAUD.)

The frog has been one of the most extensively studied laboratory animals. Yet sufficient attention has not been paid to its dietary habits particularly in the different seasons of the year, even though many species of frogs have been examined to ascertain their diet. Noble (1918, 1924) examined the stomach contents of several species of tree frogs and also of *Bufo bufo vulgaris* and *Rana temporaria*. The stomach contents of *Rana ridibunda* were examined by Smith (1953). Many others such as Needham (1905), Drake (1914), Liu & Chen (1932) examined the stomach contents of *Rana catesbiana*, *Rana pipiens*, *Rana limnocharis*, and *Rana nigromaculata* respectively. Studies have also been made on the diet and the feeding habits of the edible frogs, *Rana esculenta* (Linnaeus) and *Rana pretiosa*, by Tyler (1958) and Turner (1959). The latter author has studied the seasonal variation in the diet of the western spotted-frog.

From the observations of different authors the following could be listed as the food items of frogs: larvae of various invertebrates, molluscs, insects, young batrachians, the eggs and young ones of fishes. Tyler (1958) has recovered several species of various orders of insects and has concluded that *Rana esculenta* as a species is not selective in its food habits.

The frog *Rana tigerina*, popularly known as the Indian Bull Frog on account of its large size and loud call, is widely distributed in eastern Asia. The published records on the diet of this species refer to the unusual rather than the normal food of the animal. The present study was undertaken with the object of determining the ordinary diet of the species by the examination of the stomach contents during the different months of the year.

MATERIAL AND METHODS

The frogs were collected from a small pond, mainly rain-fed, with a surface area of approximately 150 sq. ft., on the outskirts of Baroda city. The depth of the water was about 20 ft. during the rains and between 5 to 10 ft. in summer. Water weeds were plentiful and the pond fauna consisted of aquatic insects, insect larvae, small crustaceans, and snails. The average maximum/minimum temperatures during the summer (March-June), monsoon (July-October), and winter (November-February) of the year under study were

39.8/22.8, 32.4/24.4, and 31.6/13.9 in degrees centigrade, and the total rainfall 75.2, 1359.6, and 8.4 mm. respectively.

OBSERVATIONS

The frogs were captured at night when out on land to feed. They were immediately killed and the stomach contents of each were separately preserved in 5% formalin. A report on the stomach contents is presented on pp. 265-7.

DISCUSSION

Frogs are known to prefer live moving animals chiefly insects, motionless creatures often being ignored. From the observations recorded in the present study it can be noticed that there is no special selection of food: Dermaptera (Earwigs) were found in the stomachs throughout the year, but the number was greater during the months of November and February. Thus it is seen that Dermaptera formed the chief item of diet in winter when these insects are found in large numbers, while Diptera were found to be the major item during late winter and early summer.

Coleoptera were found throughout the year except in January and February. Hemiptera reached their highest mark in the month of December. They were also found in good number during the last three months of the year. Hymenoptera were taken in only when they were available in large numbers. The number of ants was high in the months of April and May. The same was the case with Isoptera.

Lepidoptera, Arachnida, and Isopoda were also occasionally found. Myriopoda were found only after the first rain, while Orthoptera were obtained throughout the year except during the months of January and February. Young frogs during the breeding period fall a prey to the adult ones. At times bigger animals like mice, birds, and geckos become the victims of the adult frogs.

During the winter the feeding was comparatively less but in the rainy season the feeding reached its highest mark as during this period the adult frogs have just finished breeding and their reserve food is all depleted. In this season the insects are also plentiful. It was also observed that frogs captured on full-moon nights contained considerably more food in their stomachs. This was apparently due to their greater ability to find food in the moonlight.

Number collected/Number of stomachs from which collected

Months	January	February	March	April	May	June	July	August	September	October	November	December	Remarks
No. of stomachs examined ..	10	11	15	16	9	24	21	11	15	13	18	24	..
Contents													
Mollusca Snail (*Limnaea gulnaria*) ..	..	..	..	..	..	..	..	..	[a]1/1	1/1	..	..	[a]Shell
Annelida Earthworms (*Pheretima* sp.) ..	..	..	..	..	..	..	4/1	..	1/1	2/1	..	2/1	..
Arthropoda *Class* Diplopoda Millipedes ..	..	..	..	..	..	..	27/19	2/1	3/2	..	..	..	..
Class Chilopoda Centipedes ..	..	..	..	..	..	..	..	..	..	..	..	1/1	..
Thysanura ..	..	..	..	..	..	1/1	..	..	..	..	..	..	..
Lepisma sp. ..	..	..	..	..	1/1	3/1	..	..	..	..	..	..	..
Class Insecta Dictyoptera Cockroach (Blattidae)	..	..	1/1	..	..	..	1/1	[b]1/1	..	..	..	2/1	[b]With a ootheca
Isoptera (Termites) ..	..	..	..	..	[c]Several/5	[c]50+/6	1/1	..	..	..	..	..	[c]Winged forms
Orthoptera Mole Cricket (*Gryllotalpa* sp.) ..	..	..	7/5	1/1	2/1	25/11	10/4	..	2/2	23/10	4/4	3/1	

Months	January	February	March	April	May	June	July	August	September	October	November	December	Remarks
No. of stomachs examined ..	10	11	15	16	9	24	21	11	15	13	18	24	..
Contents													
DERMAPTERA (Earwigs) ..	13/5	20/11	1/1	2/1	1/1	6/4	2/1	2/2	7/3	10/4	12/6	7/3	..
HEMIPTERA (Bugs) ..	..	1/1	..	..	..	..	1/1	..	4/1	2/2	..	..	..
Geranium Bug (*Cydnis indicus*) ..	..	..	1/1	..	1/1	..	..	..	..	..	17/5	137/17	..
COLEOPTERA Families: Cicindelidae, Scarabidae, Curculionidae, Tenebrionidae ..	..	2/1	7/5	4/4	14/6	20/8	36/18	14/7	15/7	18/6	11/5	12/6	..
LEPIDOPTERA Moths (Rhaphalocera) ..	..	6/4	..	..	..	4/2	2/1	[d]8/4	[d]9/5	[d]4/2	1/1	..	[d]Larvae
DIPTERA *Eristalis* sp. (larvae) ..	21/8	27/9	30/12	22/9	1/1	1/1	..	..	..	3/3	6/6	..	..
Housefly (*Musca*) ..	..	..	..	..	..	..	2/1	4/2	2/2	..	..	..	..
Other Diptera larvae ..	..	..	..	..	..	..	..	..	[e]4/2	..	..	215/6	[e]Mosquito larvae

Months	January	February	March	April	May	June	July	August	September	October	November	December	Remarks
No. of stomachs examined ..	10	11	15	16	9	24	21	11	15	13	18	24	..
Contents													
Hymenoptera Formicidae (Ants) ..	..	2/2	..	18/3	35/7	30/9	7/3	18/8	5/1	..	4/3	12/4	..
Class Arachnida Spiders (Aranae) ..	..	1/1	..	1/1	..	2/1	..	3/3	4/2	..	..	10/3	..
Vertebrata *Class* Amphibia Juvenile Bull Frog (*Rana tigerina*) ..	..	..	..	..	..	..	1/1	4/2	2/2	1/1	..	..	..
Class Reptilia Gecko (*Hemidactylus* sp.) ..	..	..	..	..	...	1/1	..	..	1/1	..	..	..	..
Class Aves ..	..	..	..	[f]1/1	..	..	..	..	..	..	..	[g]1/1	[f] Parts of the body [g] Wings, feathers, legs
Class Mammalia *Mus* sp. ..	..	..	..	..	[h]1/1	..	..	..	..	1/1	..	..	[h] Entire mouse
Vegetable Matter ..	..	PG/1	..	..	..	..	..	..	LO/2	..	..	..	PG=Paddy grains LO=Leaves of onion

The type and number of the prey caught depends more on the availability of these animals during certain seasons rather than any particular preference.

DEPARTMENT OF ZOOLOGY,
M.S. UNIVERSITY,
BARODA,
March 16, 1962.

U. L. WADEKAR

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12. FURTHER STUDIES ON INDIAN SPIDERS OF THE GENUS *CYRTARACHNE* (FAMILY ARGIOPIDAE)

(*With four text-figures*)

INTRODUCTION

The Oriental spiders of the genus *Cyrtarachne* were first described by Thorell (1895). Pocock (1900) recorded two known and one new species. Tikader (1960) revised the Indian spiders of this genus and recorded two known and three new species.

Recently, I have received from my friend Dr. F. Schmid, some interesting spiders of the genus *Cyrtarachne* collected by the Swiss/Indian Zoological Expedition 1960-61. He made this collection from Assam and NEFA. during his Trichoptera collection tour. I have also made some collection of spiders of this genus from Maharashtra and Mysore States.

While examining the above-mentioned material of spiders, I came across four new and three known species. The present paper contains descriptions of the four new species. The type specimens will, in due course, be deposited in the collections of the Zoological Survey of India, Calcutta.

Cyrtarachne inaequalis Thorell

Cyrtarachne inaequalis Thorell, 1895, Spiders of Burma, London : 201 ; Pocock, 1900, Fauna Brit. India, Arach. : 229 ; Tikader, 1960, *J. Bombay nat. Hist. Soc.* 57 (3) : 548.

Material: 1 ♀ from Songpekmum, Manipur, Assam, 1-9-1960. Coll. Dr. F. Schmid.

Distribution: Burma: Toungoo and Tharrawaddy; India: West Bengal, Balaghat, Madhya Pradesh, Songpekmum, Manipur, Assam.

Cyrtarachne raniceps Pocock

Cyrtarachne raniceps Pocock, 1900, Fauna Brit. India, Arach. : 229 ; Tikader, 1960, *J. Bombay nat. Hist. Soc.* 57 (3) : 550 ; 1963, *J. Poona University* 23 : 41.

Material: 1 ♀ from Kotigehar, Dist. Chikmagalur, Mysore, 29-12-1960. Coll. B. K. Tikader.

Distribution: India: West Bengal, Mysore; Ceylon.

Cyrtarachne gravelyi Tikader

Cyrtarachne gravelyi Tikader, 1960, *J. Bombay nat. Hist. Soc.* 57 (3) : 553.

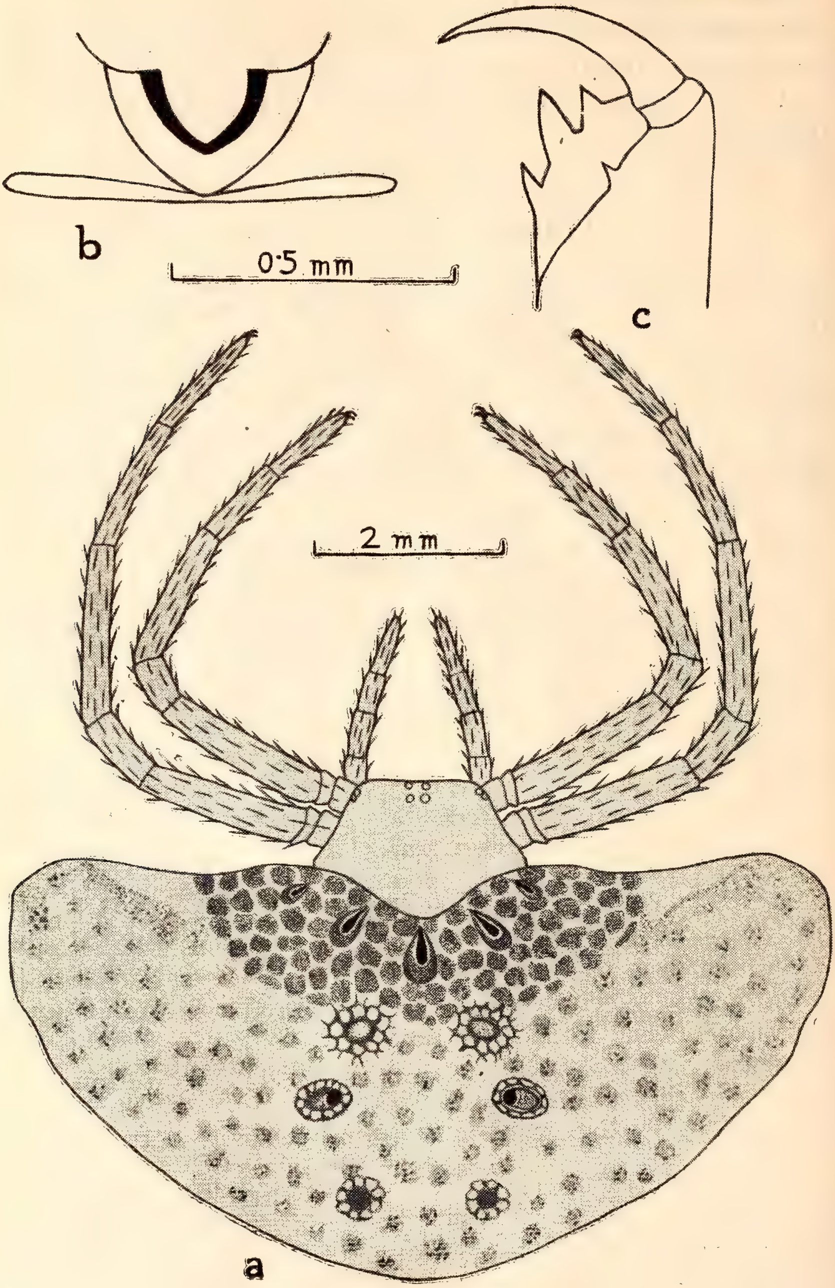
Material: 1 ♀ from Khaorang, Manipur, Assam, 28-8-1960. Coll. Dr. F. Schmid.

Distribution: India: Pashok, Dist. Darjeeling, West Bengal (Type locality), and Manipur, Assam.

Cyrtarachne avimerdaria sp. nov.

General: Cephalothorax and legs light brown, abdomen chocolate in colour. Total length 5.10 mm. Carapace 2.00 mm. long, 2.20 mm. wide; abdomen 3.70 mm. long, 8.50 mm. wide.

Cephalothorax: Relatively broader in front, slightly wider than long. Ocular quad slightly longer than wide, median eyes encircled by a black ring on the base, lateral eyes smaller than medians. Clypeus narrow. Chelicerae subapically with outer row of three large



Text-fig. 1. *Cyrtarachne avimerdaria* sp. nov.

a. Dorsal view of female ; *b*. Epigyne ; *c*. Chelicera teeth and inner row only one small tooth. Text-fig. 1, *c*. Sternum heart-shaped, pointed behind. Legs short, clothed with hairs.

Abdomen: Strongly rounded posteriorly and overlapping the posterior region of cephalothorax in front, much wider than long, dorsal surface provided with brown granular patches but anterior portion deeper than the other parts of abdomen and the anterio-lateral portion also provided with a pale patch. Epigyne V-shaped at the base as in Text-fig. 1, *b*.

Holotype: One female in spirit.

Type-locality: Cherrapunji, Assam, 15-10-1960. Coll. Dr. F. Schmid.

This species resembles *Cyrtarachne bengalensis* Tikader but is readily separated as follows: (i) Abdomen chocolate colour and strongly rounded posteriorly and dorsal surface provided with brown granular patches, but in *C. bengalensis* abdomen uniform chocolate colour and moderately rounded posteriorly. (ii) Chelicerae subapically with outer row of three large teeth and inner row with only one small tooth, but in *C. bengalensis* chelicerae with outer row of three large and inner row of three small teeth.

Cyrtarachne schmidi sp. nov.[1]

General: Cephalothorax and legs light yellowish, abdomen light greenish. Total length 4.80 mm. Carapace 1.50 mm. long, 2.00 mm. wide; abdomen 3.50 mm. long, 8.00 mm. wide.

Cephalothorax: Relatively broad in front, wider than long. Ocular quad square, lateral eyes smaller than medians. Clypeus narrow. Chelicerae subapically with outer row of three medium size teeth and inner row of two small teeth. Text-fig. 2, *f*. Sternum heart-shaped, pointed behind. Legs short, clothed with hairs.

Abdomen: Wider than long, triangular, strongly overlapping the posterior region of cephalothorax in front; broadest in its anterior half. When living abdomen dark, greenish brown with a narrow yellowish belt laterally and posteriorly. Almost all sigilla yellow in centre and encircled by brown patch. Epigyne as in Text-fig. 2, *e*.

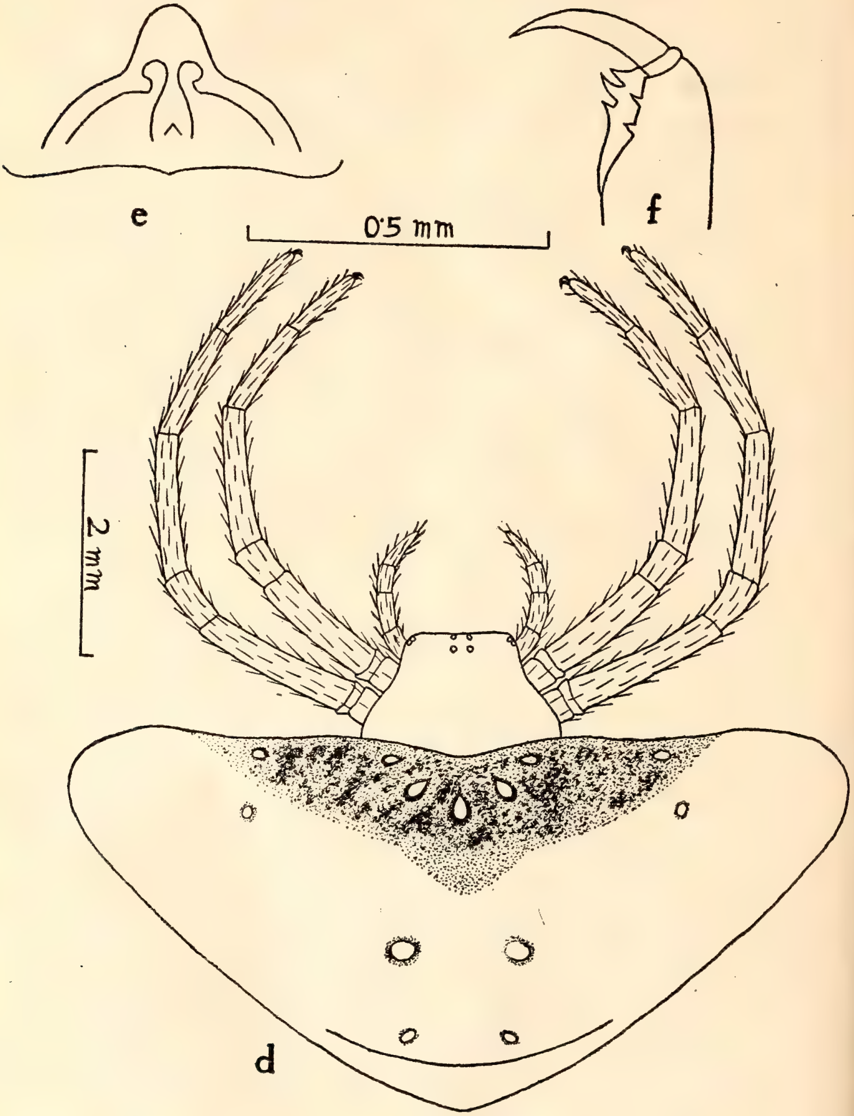
Holotype: One female in spirit.

Type-locality: Amatulla Kameng (NEFA.), India, alt. 1500 feet (*c*. 460 m.), 18-10-1961. Coll. Dr. F. Schmid.

---

[1] I have pleasure in naming this species after Dr. F. Schmid, who made this collection.

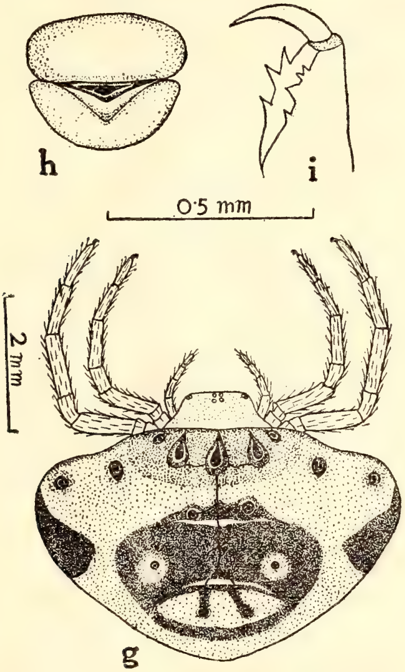
This species is closely allied to *Cyrtarachne biswamoyi* Tikader but differs as follows: Abdomen wider than long and triangular in shape, but in *C. biswamoyi* abdomen wider than long and widely rounded posteriorly, dorsal surface armed with a few symmetrically placed tooth-like tubercles.



Text-fig. 2. *Cyrtarachne schmidi* sp. nov.
d. Dorsal view of female ; *e.* Epigyne ; *f.* Chelicera

Cyrtarachne sundari sp. nov.

General: Cephalothorax, legs and abdomen brownish red. Total length 4.00 mm. Carapace 1.00 mm. long, 1.60 mm. wide; abdomen 3.50 mm. long, 5.50 mm. wide.



Text-fig. 3. *Cyrtarachne sundari* sp. nov.

g. Dorsal view of female ; *h*. Epigyne ; *i*. Chelicera

Cephalothorax: Relatively broader in front, slightly wider than long. Ocular quad slightly longer than wide, lateral eyes smaller than medians. Clypeus narrow. Chelicerae subapically with outer row of three large teeth and inner of four small teeth. Text-fig. 3, *i*. Sternum heart-shaped, pointed behind. Legs short, clothed with hairs.

Abdomen: Moderately rounded posteriorly, strongly overlapping the posterior region of cephalothorax in front, wider than long, the anterior lateral and mid-dorsal areas furnished with dark brown patches. All sigilla prominent and encircled by a yellowish ring. Epigyne as in Text-fig. 3, *h*.

Holotype: One female in spirit.

Type-locality: Poona University Compound, Maharashtra, 6-9-1962. Coll. B. K. Tikader.

This species resembles *Cyrtarachne bengalensis* Tikader but is separated as follows: (i) Abdomen brownish red and the anterior lateral and mid-dorsal areas furnished with dark brown patches, but in *C. bengalensis* abdomen pale chocolate colour and anterior lateral extremities with a white patch; (ii) Chelicerae subapically with outer row of three large teeth and inner row of four small teeth, but in *C. bengalensis* outer row of chelicerae with three large teeth and inner row with three small teeth.

Cyrtarachne promilai sp. nov.

General: Cephalothorax light brown, legs light greenish, and abdomen dark or deep brown. Total length 5.00 mm. Carapace 1.50 mm. long, 2.40 mm. wide; abdomen 4.00 mm. long, 7.00 mm. wide.

Cephalothorax: Relatively broader in front, wider than long. Ocular quad as long as wide, lateral eyes small. Chelicerae subapically with outer row of three large teeth and of two small teeth. Text-fig. 4, *l*. Clypeus narrow. Sternum heart-shaped pointed behind. Legs short, clothed with hairs.

Abdomen: Wider than long, nearly pentagonal in shape strongly overlapping the posterior region of cephalothorax in front, broadest in its anterior half. Almost all sigilla yellow in centre and encircled by black patch. Epigyne simple as in Text-fig. 4, *k*.

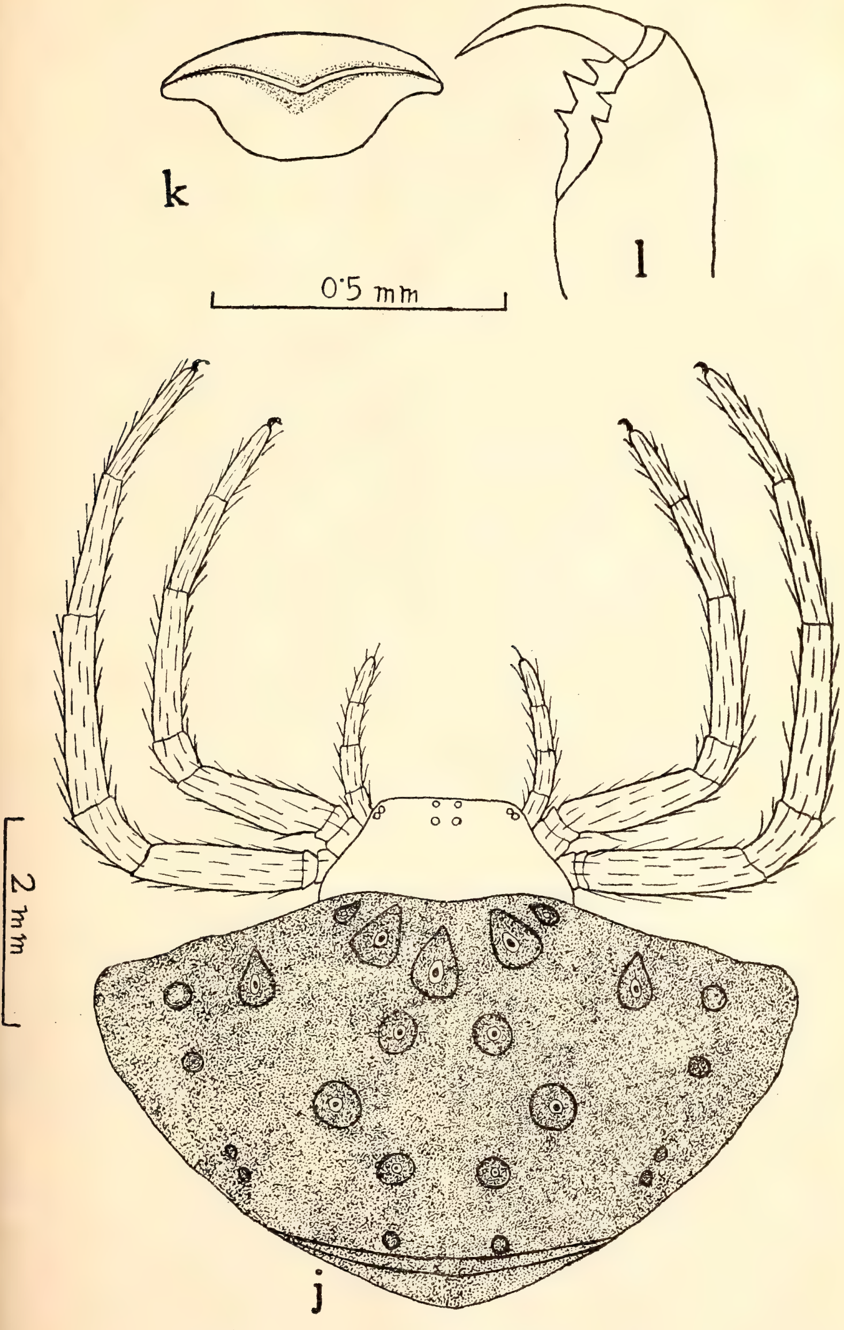
Holotype: One female in spirit.

Type-locality: Poona University Compound, Maharashtra, 6-9-1962. Coll. B. K. Tikader.

This species resembles *Cyrtarachne biswamoyi* Tikader but is readily separated as follows: (i) Abdomen wider than long and pentagonal in shape and dark or deep brown colour, but in *C. biswamoyi* abdomen wider than long and armed above with a few symmetrically-placed tooth-like tubercles; (ii) Abdomen deep brown, but in *C. biswamoyi* abdomen light yellowish grey.

SUMMARY

Four new and three known species of Indian spiders of the genus *Cyrtarachne*, family Argiopidae, are recorded in this paper. All specimens were collected from Assam, NEFA, Maharashtra, and Mysore, India.


k
l
0·5 mm
2 mm
j

Text-fig. 4. *Cyrtarachne promilai* sp. nov.
j. Dorsal view of female ; *k*. Epigyne ; *l*. Chelicera

ACKNOWLEDGEMENT

I am thankful to Dr. F. Schmid, who kindly made some of the interesting collection of *Cyrtarachne* spiders available for my studies.

WESTERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
POONA,
December 27, 1962.

B. K. TIKADER

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13. NOTES ON A COLLECTION OF TICKS WITH A NEW HOST RECORD OF *HYALOMMA AEGYPTIUM FEROZDENI* SHARIF (IXODIDAE)

Recently I had an opportunity to study a small collection of Ixodid ticks received from the Head of the Department of Zoology, Panjab University, Chandigarh. The material includes: (i) *Hyalomma aegyptium ferozdeni* Sharif—2 ♂♂, Chandigarh, Panjab (off donkey), 15-7-1961; (ii) *Hyalomma aegyptium aegyptium* (Linnaeus)—8 ♂♂, 4 ♀♀, Ferozpore, Panjab (off camel) 30-7-1961; (iii) *Rhipicephalus sanguineus* (Latreille)—4 ♂♂, 2 ♀♀, Chandigarh, Panjab (off donkey), 15-7-1961.

Four subspecies of *Hyalomma aegyptium* (Linnaeus) are known, viz. *H. aegyptium aegyptium* (Linn.), *H. aegyptium dromedari* Koch, *H. aegyptium isaaci* Sharif, and *H. aegyptium ferozdeni* Sharif. Sharif (1928) reviewed the taxonomy, distribution, and hosts of these subspecies.

H. aegyptium ferozdeni Sharif (1928) was described from 3 ♂♂, and 1 ♀ specimen, found to be parasitic on cattle from Sasaram, Shahabad District, Bihar. Sharif also recorded it on cow (Chatra, Hazaribagh District, Bihar), on pony (Sasaram, Shahabad District, Bihar), and on buffalo (Porahat, Singhbhum District, Bihar). According to Sen (1938) cattle (*Bos indicus*), buffalo (*Bubalus bubalis*), and horse (*Equus cabalus*) only are the hosts of *H. aegyptium ferozdeni*.

This collection is quite interesting for two reasons. A perusal of the literature shows that the subspecies *ferozdeni* has not hitherto been recorded on donkey; secondly, this is the first record of its occurrence outside Bihar State.

Nagar (1962), while working on the ticks of Delhi State, expressed the view that both *H. aegyptium ferozdeni* Sharif and *H. aegyptium isaaci* Sharif belong to *H. detritum* Schulze, *H. aegyptium* f. *aegyptium* (Linn.) to *H. excavatum* Koch, and *H. aegyptium dromedari* Koch to *H. dromedari* Koch. In the present paper, Sharif's (1928) key has been followed, pending further research on the systematics of these species. Incidentally, it may be worth mentioning that *H. detritum* Schulze is also not recorded on donkey.

In the present case *H. aegyptium ferozdeni* has been found associated with *Rhipicephalus sanguineus*, which is of considerable economic importance as the vector of malignant jaundice of dogs in India caused by *Babesia canis* (Piana & Galli-Valerio) and of Marseilles fever due to *Rickettsia conori* Brumpt in the Mediterranean region and Kenya colony, and which is a suspected vector of tick typhus fever in man and *Babesia gibsoni* (Patton) in jackals and dogs in India (Sharif 1938). It may be interesting to investigate whether *H. aegyptium ferozdeni* plays a part in the distribution of the diseases transmitted by *Rhipicephalus sanguineus*.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA 12,
December 24, 1962.

G. MATHAI,
Asst. Zoologist

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14. OCCURRENCE OF THE BUTTERFLIES *HYPOLIMNAS MISIPPUS* FORM *INARIA* (CRAMER) AND *CIRROCHROA THAIS* (FABRICIUS) IN THE SURAT DANGS, SOUTH GUJARAT

The Danaid Eggfly [*Hypolimnas misippus* (Linnaeus)] is found in India, Ceylon, and Burma. Its range includes also southern Florida, the Antilles, and the northern part of South America. It is very common in Africa, tropical Asia, and the islands south as far as northern Australia (Holland, 1940).

Male and female Danaid Eggflies are common in the Dangs, but the female is more seclusive and less commonly observed. In addition to the regular female form of the Danaid Eggfly there are two rare female forms: '*alcippoides*', which mimics the '*alcippoides*' form of *Danaus chrysippus*, and '*inaria*', which mimics the '*dorippus*' form of *D. chrysippus*. Wynter-Blyth (1957) states that the female form '*inaria*' is very rare but not as rare as the form '*alcippoides*'.

On 28 September 1960 one '*inaria*' was sighted at Ahwa. Another was seen on 29 September 1960 at Mulchond. Again on 23 August 1962 one escaped capture at Ahwa. On 12 September 1962 the writer saw this rare '*inaria*' form in his garden at Ahwa. By the time a net had been found this butterfly had flown into a near-by rice field. After several futile swings of the net and wading through a muddy rice field, a perfect specimen of *Hypolimnas misippus* ♀ form '*inaria*' was captured.

It was not difficult to recognize this female form from the dozens of the common female *H. misippus* captured in the past sixteen years of collecting in India. In the female form '*inaria*' the front wings have the elongated spots yellowish, instead of white as in the common female form; also, the middle of the black apical area is tawny in the '*inaria*' form.

On 27 September 1962 the writer caught another rare butterfly a Tamil Yeoman *Cirrochroa thais* (Fabricius) in the Mission compound at Ahwa while it was feeding on nectar from *Lantana* flowers.

Wynter-Blyth (1957) states that the Tamil Yeoman is found in Ceylon, the Western Ghats, Coorg, Wynaad, the Nilgiris, and the Palnis (p. 227), and remarks that it is commonest in south India from February to May (p. 228). He gives its size as 60-70 mm. The specimen netted measures $2\frac{1}{2}$ inches (about 64 mm.). The writer has collected butterflies in the Surat Dangs since October 1952 and frequently in various parts of Gujarat since 1946, but not a single species of *Cirrochroa* genus was ever observed in this large area.

C. B. Antram (1924) gives the range of the Tamil Yeoman as southern India (p. 194). Marshall & De Niceville (1886) give a complete description of the genus *Cirrochroa* (pp. 107-119). Here the habitat of *C. thais* is listed as south India. According to the records of the Bombay Natural History Society *C. thais* has been taken only as far north as Karwar in Mysore State.

Thus, the capture of a Tamil Yeoman in south Gujarat extends its northern range by about five hundred miles. However, the presence of a single *Cirrochroa thais* (Fabricius) in Gujarat State is probably an accidental occurrence.

ACKNOWLEDGEMENT

The writer expresses gratitude to the Bombay Natural History Society for providing several boxes of *Cirrochroa* butterflies for study.

DANGS RURAL BOARDING SCHOOL,
CHURCH OF THE BRETHREN MISSION,
AHWA, VIA BILLIMORA, DANGS DIST.,
November 29, 1962.

ERNEST M. SHULL

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15. THE MATING OF THE ATLAS MOTH *ATTACUS ATLAS* LINNAEUS

In September last year, when I was taking photographs of some landslides on one of our estates (Balur Estate, alt. 3500 ft.) with a colleague, we suddenly came on two pairs of Atlas Moths (*Attacus atlas* Linnaeus) mating about ten feet from one another. They were on small bushes about 4 to 5 feet in height. The moths were facing each other with the lower portions of their abdomens touching, and were clinging to a cocoon presumably the one from which the female had emerged.

They took not the slightest notice of us even when we approached very close to them. When we disturbed one of the pairs, the larger of the two, the female, flopped to the ground. The male flew only a few yards and alighted on a coffee bush from where it was caught. Although we caught the female and threw her gently up in the air she seemed unable to fly and, after fluttering about, flopped on to the ground.

I regret I was unable to watch them mating over a longer period, as I had very little time and had to return to my estate the same evening.

MYLEMONEY ESTATE,
JOLADALU P.O.,
CHIKMAGLUR DIST.,
MYSORE STATE,
December 13, 1962.

K. R. SETHNA

16. DETAILED DESCRIPTION OF DIASPINE SCALE INSECT *CHIONASPIS VENUI* MENON & KHAN, 1961. (DIASPIDIDAE : COCCIDEA)[1]

(*With a plate*)

The authors came across certain specimens of Diaspine scale insects in the National Pusa Collection, which on closer study proved to be a new species of the genus *Chionaspis* Signoret. A short description of the same was published in 1961 (Menon & Khan 1961). A detailed description is given here. It is confined to the female, as a complete male specimen has not been available.

Chionaspis venui

Female. Body oval and distinctly segmented, broadest at the second abdominal segment; antennae knob-shaped with distinct setae, set close to each other (Fig. 3); mouth-parts of typical diaspine type; spiracles two pairs, anterior pair slightly away from the apex of the rostralis, with its anterior end surrounded by numerous quinquelocular disc pores (Fig. 5); posterior pair much smaller than anterior; ducts 'two-barred' type, about 0.015 mm. long; macroducts broader than long (Fig. 4); microducts more clearly seen in prosoma, long, thin,

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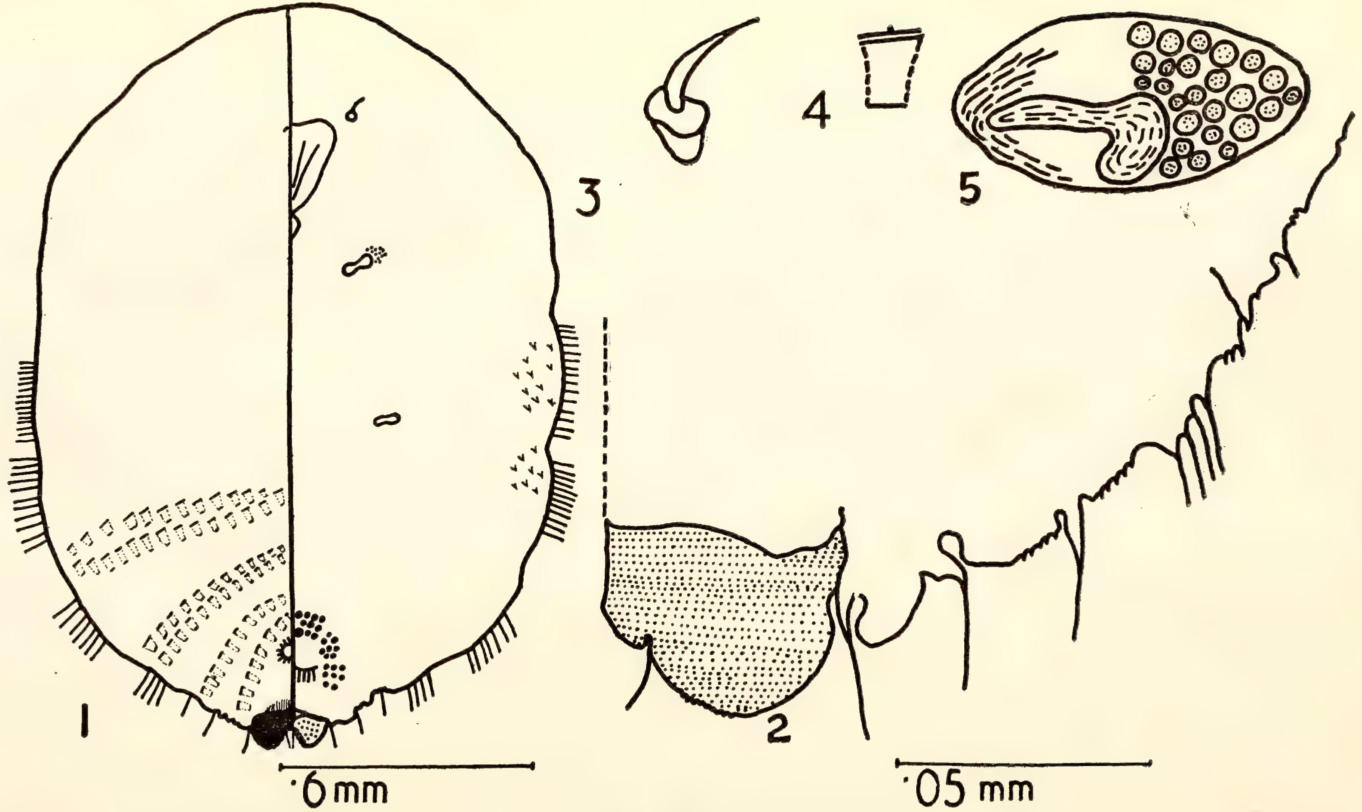
[1] Communicated by Dr. Md. Zaka-ur-Rab, Dept. of Zoology, Muslim University, Aligarh, U.P.



Chionaspis venui

1. Female holotype showing the dorsal and ventral views ; 2. Dorsal half of the right side of the pygidium showing the arrangements of the spines ; 3. Antenna ; 4. 'Double-barred' macroduct ; 5. Anterior spiracle.

and metamerically disposed in clusters; segmental rows of ducts distinctly marked into submarginal and submedian ducts; submarginal ducts more numerous on segments 3-5; submedian ducts numerous on segments 4-6; gland spines long, projecting from the body; arrangements of spines: one between median and second lobes, one between second and third lobes, one between third and fourth lobes, four on segment six, seven on segment five, and numerous on segments three and four (Fig. 1). Median lobes zygotic, round, strongly sclerotized and projecting from the margin of pygidium, inner and outer margins of median lobes faintly serrate; no gland spines present between the bases of median lobes, only a single pair of setae present between the bases (Fig. 2). Second lobe distinctly bi-lobed; first lobule well developed, apically rounded; second lobule small and conical; third lobe stumpy, with serrate margins, setae numerous. Perivulvar pores in five distinct groups; anus at a considerable distance from the median lobes.

Measurements. Length of scale of male 1.5 mm.; length of scale of female 2.901 mm., breadth of the scale of female 1.938 mm.; length of female 1.669 mm.; breadth of female 1.023 mm.; length of antennae 0.025 mm.; length of the antennal seta 0.017 mm.; length of anterior spiracle 0.06 mm.; length of posterior spiracle 0.02 mm.; length of 'two-barred' ducts 0.015 mm.; length of median lobes 0.045 mm.; length of second lobe 0.025 mm.

Habits. Occurring for the most part on leaves but also to some extent on twigs and petioles; scales of female outnumber the scales of male; dirty white, slender, and long, carina not visible; puparia conspicuous, brownish, elongate, and measuring about one-fourth of the length of male scale; scale of female dirty white, pear-shaped, exuvial end narrow, broadening gradually with posterior half almost parallel, moderately convex.

Type material. A number of females deposited in National Pusa Collection, Indian Agricultural Research Institute, New Delhi, collected on 12 March 1902.

Host plant. Ficus palmata Forsk.

Locality. Palampur, Kangra District, Panjab, India.

Discussion. The genus *Chionaspis* Signoret is represented in India by 22 species. The present species possesses certain important characters, which markedly differ from those hitherto described. It comes very close to *C. pusa* Rao and *C. manni* Green, but differs from them as follows:

Chionaspis venui Menon & Khan	*C. manni* Green	*C. pusa* Rao
1. Median lobes faintly serrate	Median lobes clearly serrate	Median lobes non-serrate
2. Second lobule of second lobe half of the first lobule	Second lobule of the second lobe a little smaller than first lobule	Second lobule of second lobe nearly equal to first lobule
3. Third lobe stumpy, without any lobule	Third lobe bi-lobed	Third lobe bi-lobed
4. Arrangements of spines: 1,1,1, 4, numerous	1,1,1, 3,6,7	1,1,1, 3,6,7
5. Antennae are not very far from each other	Antennae far from each other	Antennae very close to each other
6. Base of the antennae oval and setae emerge from above	Base of the antennae slightly serrate, setae from lateral side	Base of antennae lobed, setae long
7. Disc pores numerous in anterior spiracle	Disc pores not many in anterior spiracle	Disc pores few on anterior side of anterior spiracle
8. Anterior spiracle not very close to rostrum	Anterior spiracle close to rostrum	Anterior spiracle at a considerable distance

ACKNOWLEDGEMENT

The authors wish to thank Dr. E. S. Narayanan, Head, Division of Entomology, Indian Agricultural Research Institute, New Delhi, for his kind permission to examine the National Pusa Collection.

DEPARTMENT OF ZOOLOGY,
ALIGARH MUSLIM UNIVERSITY,
ALIGARH,
September 9, 1962.

M. G. RAMDAS MENON
M. S. H. KHAN

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17. INTELLIGENT BEHAVIOUR BY THE MASON WASP (*EUMENES PETIOLATA* FABR.)

Major R. W. G. Hingston in part III of his interesting paper on the mason wasp *Eumenes conica* (*J. Bombay nat. Hist. Soc.* **31** (4): 890-896) described the experiments by which he tested the capacity of the wasp to act intelligently. He came to the conclusion that it is far from being a mere automaton whose actions are governed by instinct. May I be permitted to describe an instance of intelligent behaviour by another mason wasp *Eumenes petiolata* Fabr. ?

I noticed her at the beginning of September 1962 building her egg-chambers against the vertical side of a concrete pillar in my verandah—I did not see when the work began. At 7.30 a.m. on the 4th a new cell was complete and ready for filling—about five or six cells had already been closed and plastered over. At 4 p.m. that day the cell had been closed and the whole construction plastered over. There was nothing to indicate that further building was contemplated and I took it that the wasp had completed her labour.

At about 4.50 p.m., I noticed that the construction had been attacked by small red ants. They were in fair numbers and fresh reinforcements were coming up. The ants were moving about over the plaster and going in and out of several little holes which did not appear to be very deep.

Coming back to the place at about 5.35 p.m. I was surprised to see the wasp back on her egg-chambers and battling with the ants. She was darting quickly backward and forward, attacking individual ants and biting them. From where I was I could not see what she did with them. I could not see wounded or dead ants lying about and it looked as if she was eating the ants. Later, however, I discovered several wounded or dead ants lying on or near the field of combat, though not enough in number to account for all the ants I saw being attacked. An explanation of this latter fact is suggested by my experience when I attempted to collect some of the victims with a painting brush—the wounded ones bit fiercely at the bristles of the brush and were dislodged with difficulty. So it is possible that many of the wounded ants held on to the wasp and were brushed off somewhere else. The wasp seemed to be able to see ants close to her, but some ants moving about slowly a little more than an inch from her escaped notice. By about 5.50 p.m. the field was pactically clear of ants and the survivors withdrew in a thin line.

From then on the wasp worked with feverish rapidity, replastering the egg-chambers. Every 1½ to 2 minutes she returned with a ball of clay about the size of a pea and spread it on in patches. The plastering took ½ to 1 minute each time according to the size of the area covered, and she started out immediately to bring her next pellet of clay. In this way she covered the whole construction, including the cells first made by her. At about 6.30, when the light was fading slightly, she flew away and did not return.

On the 5th at 8 a.m. there was no sign of activity and the wasp was not to be seen. At 9 a.m. I noticed a few red ants on the construction. There were again a few holes in it, and the ants were passing into and out of them. At about 10 a.m. the wasp appeared on the scene and came within three feet of the construction, when my two daughters and I were examining it closely. We drew away at once, but probably our sudden movement disturbed her and she departed without drawing nearer and did not come back—this was the last time she was seen. Only a few ants were at work, and fine grains of soil lying on and below the construction suggested that the ants had made the holes that we saw and that they had been at work longer than I had first imagined—probably they were there when I first inspected at 8 a.m. It was easy to overlook the presence of the ants, as I discovered later the same morning when I watched for about 10 minutes without seeing any ants and then, seeing something moving at the mouth of one of the holes, used a magnifying glass and found it to be the waving antennae of ants moving cautiously inside the hole. Similarly, in the next ten minutes apart from the waving antennae I saw only two red ants move inconspicuously on the surface of the construction for a short while.

The secret tunnelling seemed to be still in progress at 12.40 p.m. At 1.10 p.m. reinforcements arrived in a thin line and about 13 ants joined those already at work. By 1.55 p.m. the ants, though still few in number, were more openly at work, and small numbers of ants were coming and going in a thin line.

Work continued like this till the 12th. It was noticeable that on and after the 10th the grains brought out by the ants were black in colour, instead of being grains of red soil as they were before. By about the 21st all activity died down.

During all this time there were ants coming and going and moving about, but never in large numbers. Evidently the ant colony was a small one, which explains why the wasp was able to prevail in its fight with the ants. Never at any time did we notice the ants carrying away anything from the nest chambers.

I waited about three months and opened up the nest-chambers on the 17th December. There were seven cells in all, containing dry, broken-up, and shapeless remnants of dark crumbly matter. The two lowest cells, evidently the first that were built by the wasp, were completely lined with silk. Here the eggs seem to have developed up to the pupal stage; there was no sign of development in any other cell. Holes in the walls separating the cells from each other indicated that the ants had succeeded in penetrating them and had eaten the contents.

49, PALI HILL,
BANDRA, D. E. REUBEN
BOMBAY 50-AS,
December 19, 1962.

18. *ODONTOTERMES OBESUS* RAMB. AS A PEST OF JAPANESE MINT

(*With two plates*)

The termite *Odontotermes obesus* Ramb., the common mound-building termite, is widely distributed throughout India and has been observed to attack a large number of trees like *Grevillea*, Coconut Palm, *Ficus*, etc. in addition to sugar-cane setts, paper, cloth, and other articles of economic importance. The insect is an occasional wood-eater, otherwise making fungus beds for its food.

The present paper describes damage to standing crop of *Mentha arvensis haplocalyx* Briquet var. *piperascens* Holmes, the common Japanese mint, cultivated for the production of mint oil and menthol.

Japanese mint is a perennial herb propagated by suckers, planted in February. It begins to sprout after spring rains in early March. The aerial portions of the plant are harvested and distilled. A first crop is usually harvested in June-July and a second in October. This is an essential oil-bearing plant of major economic importance.

The attack was observed in May at Chakrohi, Jammu District, J. & K. State, and attacked plants were collected from Miran Sahib farm at Jammu District in early August 1962, by the authors. The attack was more intensive on plants growing on raised portions of the field. It was first thought that this withering was due to some soil fungi but closer examination revealed the presence of numerous termites.

The affected portion of the field looked dry. In fact 50-60% of the plants were either in a process of drying or totally dry. In addition some of the green plants were also found to be attacked. Of these, 15-20% had no roots at all and showed symptoms of wilting. A good number of the others had no main root but were sustained by the presence of side shoot or shoots, supplying necessary nutrients to the main stem (Plate II, C).

The infested plants show progressive wilting from the lower leaves upwards, and growth is inhibited as the roots are continuously eaten by the termites. This wilting is succeeded by gradual drying and yellowing of the leaves and the plant ultimately dies when no side shoots are thrown out with supporting roots to supply the necessary nutrients. Sometimes the roots are eaten up so fast that the plants remain standing as such while the root is totally consumed (Plate II, D).

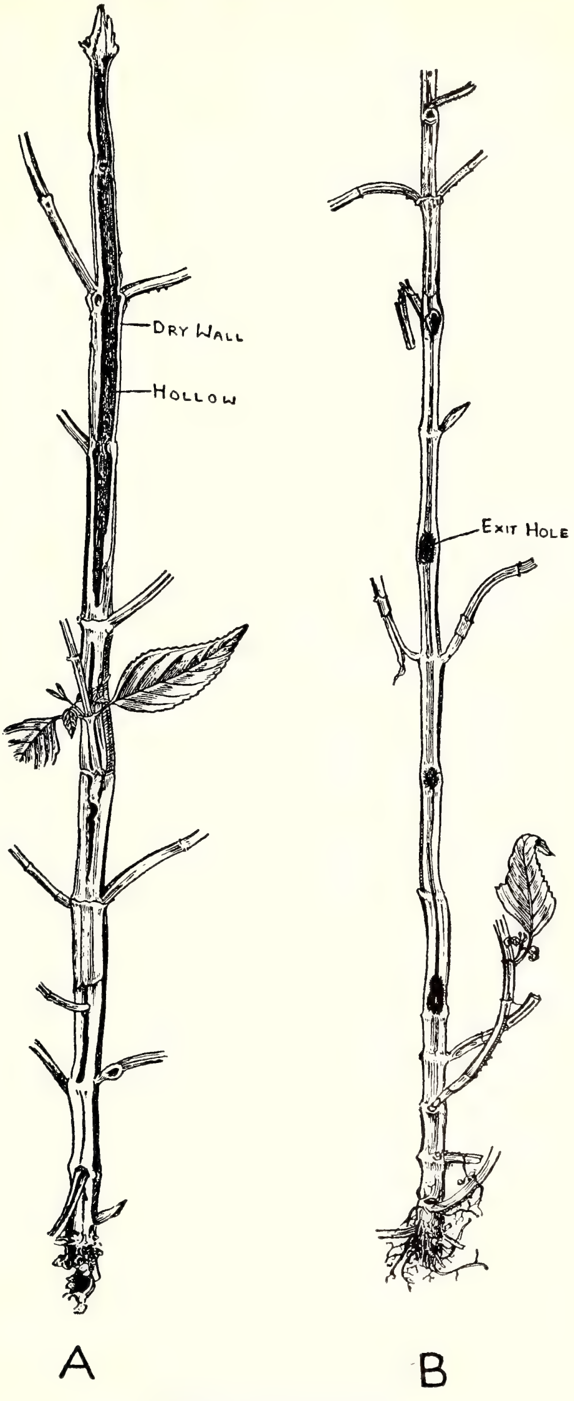
The damage is usually restricted to the underground parts which are destroyed partially or completely by the termite leaving no trace of the root in the soil. At times, when the injury is not confined to the roots alone, the insect enters the stem by tunnelling through the cortex into the pith of the stem. The epidermis together with the left-over hypodermal portion dries up but is strong enough to keep the dry plant standing on the soil. In certain other cases, these termites have been observed to go up to the very tip of the shoot that they infest. In this case the insects were observed to have one or several exit holes to the outside on the hollow stem. Many holes are therefore observed on the dry, hollow, standing stem (Pl. I, B and II, E, *a*). This mode of boring out is in no way universal and at times the termites find their way back through the tunnel through which they enter (Pl. II, D, *a*).

A split stem at this stage of acute infestation shows a hollow tunnel formed of the original vascular and cortical regions together with the hollow pith, surrounded by a thick or thin layer of epidermal and hypodermal cells (Pl. I, A and II, F). Sometimes the hollow tunnel is seen to be full of a spongy, clayey substance together with black particles of organic matter and fungus bodies.

Termite mounds, about 6 ft. tall, were located in a garden adjacent to the infested fields of Miran Sahib farm, and a smaller one about a foot in height was found at the base of a tree near the infested field.

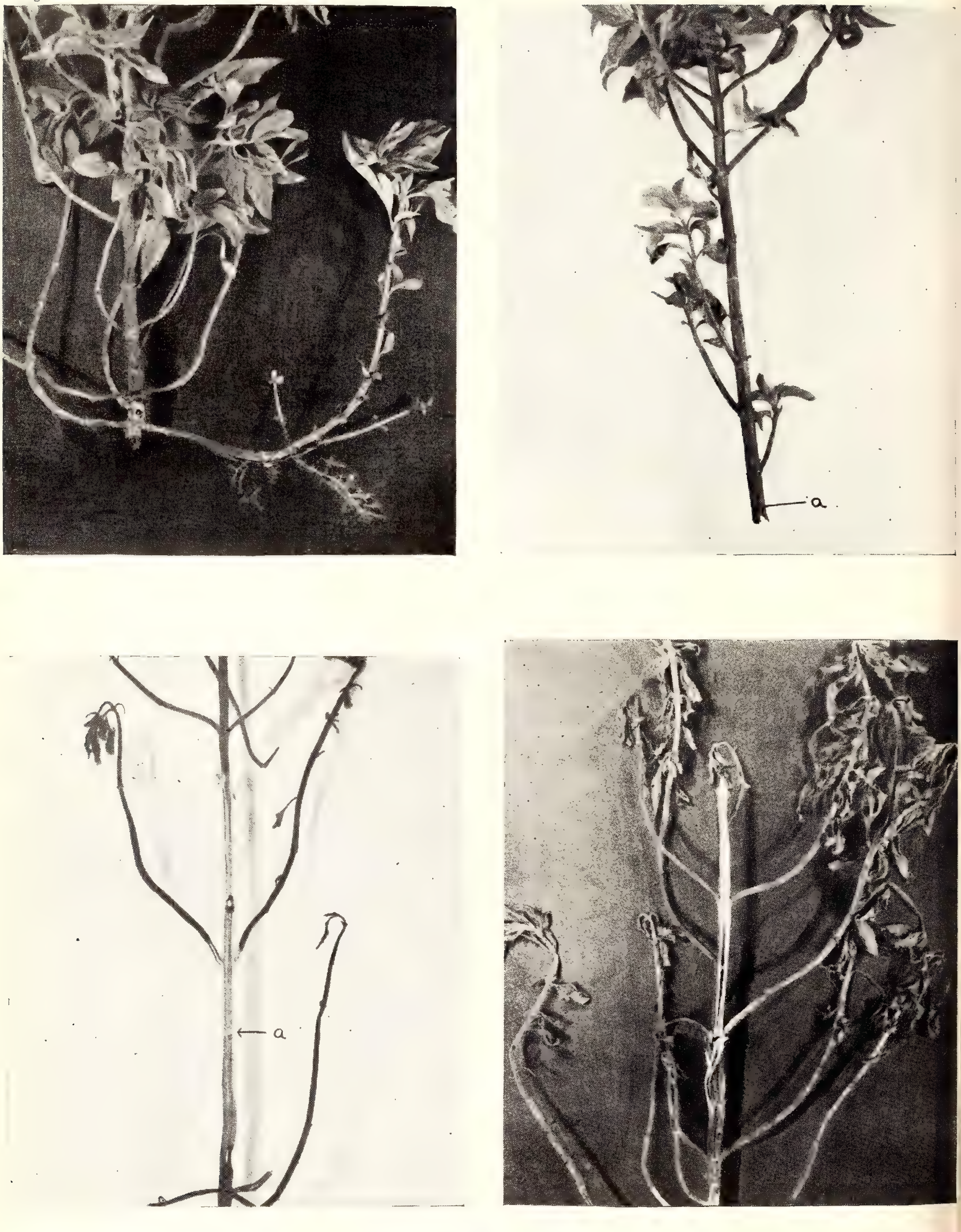
CONTROL

(1) As the attack is more intensive on plants growing on raised patches of soil, levelling of the field is recommended.


Dry Wall
Hollow
Exit Hole
A
B

Japanese Mint Plant

A. Showing the split stem. Only a thin wall is left encircling a hollow; *B.* Showing the holes made by the termites for their exit.



Japanese Mint Plant

C. The Plant is still green though the original root is missing. The side shoot with roots is also seen; *D.* The plant appearing normal and green but devoid of any root (a); *E.* The 'Exit Holes' formed by the termites (a); *F.* Stem split longitudinally to show the hollow and the surrounding dry epidermal and hypodermal portions.

(2) As soon as the attack is observed, a light hoeing to allow water to percolate through the soil, followed by flood-watering for 24-36 hours, is found to be an effective deterrent.

(3) *Heptaf*, a 3% Heptachlor dust at the rate of 40-50 lb. per acre is recommended. The chemical should be dusted in rows and raked into the soil to effect fair mixing.

This, as far as we know, is the first record of this termite attacking Japanese mint.

ACKNOWLEDGEMENTS

The authors wish to express their sincere thanks to the Director, Commonwealth Institute of Entomology (British Museum of Natural History) and Dr. M. L. Roonwal, Director, Zoological Survey of India, for their valuable help in identifying the termite.

RAJENDRA GUPTA
M. K. AGARWAL

CENTRAL INDIAN MEDICINAL PLANTS ORGANISATION,
(COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH)
OLD MILL ROAD,
NEW DELHI,
February 19, 1963.

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19. THE TERMITE *CRYPTOTERMES HAVILANDI* (SJÖSTEDT) FROM THE INTERIOR OF INDIA[1]

(*With a plate*)

Species of the genus *Cryptotermes* are dry-wood termites and are serious pests of woodwork in buildings, household furniture, etc. They are generally restricted to the coastal regions and islands.

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[1] Communicated by Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta.

Until now there has been only a single specific record of the genus from an area at a distance from the coast, viz. Ituri Forest, Belgian Congo, Africa (Emerson 1952).

Cryptotermes havilandi (Sjöstedt) [=*C. bengalensis* Snyder] (Family : Kalotermitidae) has been recorded from the Ethiopian, Malagasy, Neotropical, and Oriental regions. Its native habitat appears to be the eastern coast of Africa, south of the Sahara Desert, where it exists in a natural state. It has been found to occur in human habitations on the western coast of Africa and in Brazil (South America), where it has been regarded as a serious pest.

From India *Cryptotermes havilandi* has been recorded by Snyder (1934) from the Sundarbans (Sea Forest, Bengal) as *C. bengalensis* sp. nov. from the wood of *Heritiera fomes*, and by Beeson (1941) from the woods of *Heritiera fomes* and *Erythrina indica.* Roonwal & Pant (1953) and Roonwal & Chhotani (1962) have recorded this species from Jokhai Reserve (Assam), Sundarbans (Bengal), and Dacca (East Pakistan).

During a survey in November 1959, I found this species nesting in a branch of *Ficus bengalensis* Linn. at Mandla Fort (lat. 22° 43′ N., long. 88° 35′ E.) in Madhya Pradesh. This town is located in hilly area (alt. *c.* 450 m.) on the banks of Narbada River and about 600 km. from the nearest sea-coast. From this present record, and the previous record of Jokhai Reserve Forest (lat. 27° 10′ N., long. 95° 25′ E.) by Roonwal & Pant (1953) and Roonwal & Chhotani (1962), which also is about 600 km. from the nearest sea-coast, it appears that after introduction into India the species travelled inland (probably through human agency—infested wood) and later got established in a semi-wild state far inland.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA 12,
November 2, 1962.

O. B. CHHOTANI

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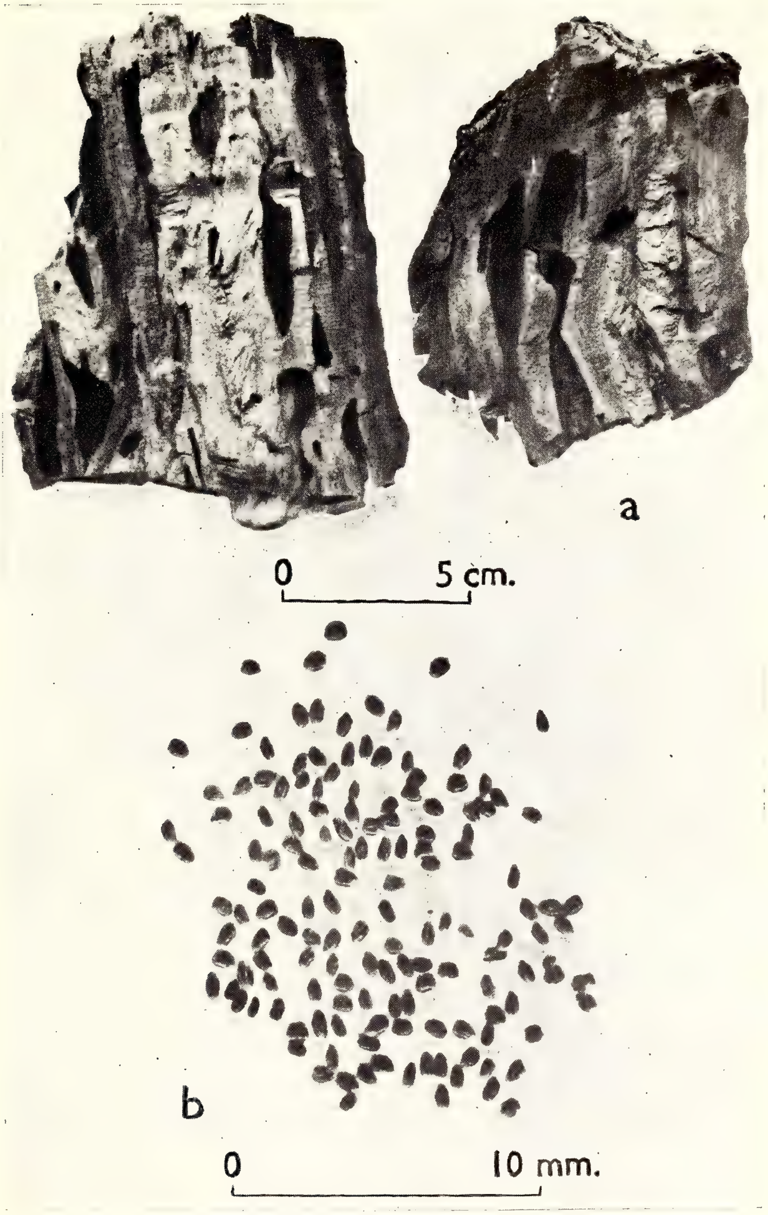
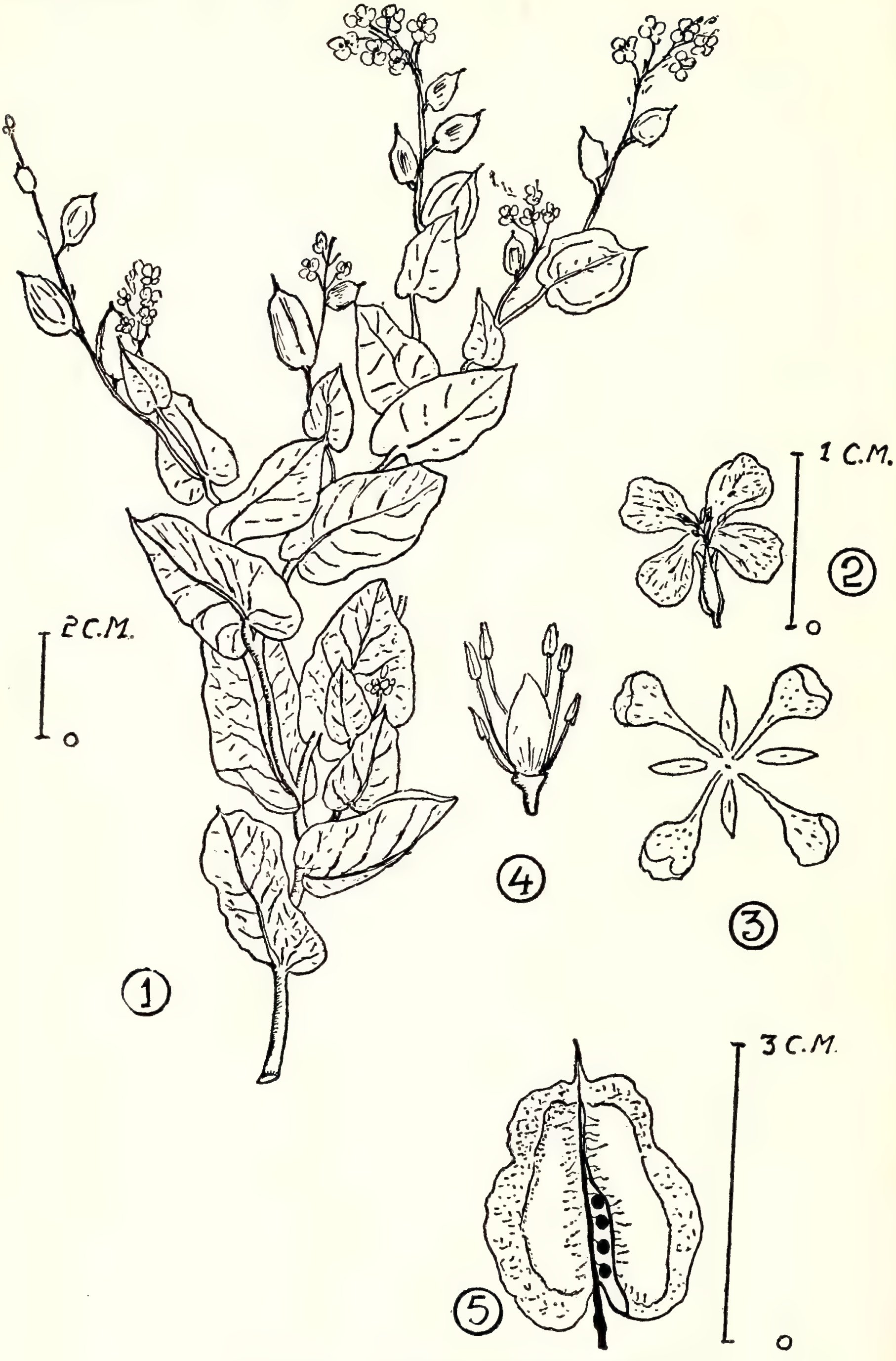


Cryptotermes havilandi (Sjöstedt)

(*a*) Damaged wood of *Ficus bengalensis* Linn. (*b*) faecal pellets. Mandla Fort (Madhya Pradesh, India) coll. O.B. Chhotani, November, 1959.


1 C.M.
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Schouwia purpurea (Forsk.) Schweinf.

(1) A branch with leaves, flowers, and fruits ; (2) Entire flower ; (3) Petals and sepals ; (4) Tetradynamous stamens ; (5) Siliqua.

20. OCCURRENCE OF *SCHOUWIA PURPUREA* (FORSK.) SCHWEINF.=*S. ARABICA* DC. IN INDIA

(*With a plate*)

An erect, much branched leafy undershrub, 60-90 cm. high; spreading about 80 cm.; stem glabrous, divaricately branched. Leaves simple, sessile, semi-amplexicaul, 4-5 by 2-3 cm. long; ovate glaucous, green.

Flowers violet, in terminal and in leaf-opposed racemes. Sepals 5 mm. long sub-erect, more or less saccate; the margins dull white. Petals 7 mm. long, spathulate, violet, truncate, varied. Stamens 6, tetradynamous, the 4 inner 5 mm. long; the 2 outer 3.5 mm. long. Siliqua more or less orbicular or obcordate, about 2 cm. across, flat with an ensiform seedless beak. Seeds many, 2-seriate, round, reddish brown with cotyledons conduplicate.

The plant is not mentioned either in Cooke's FLORA OF BOMBAY (1901) or Hooker's FLORA OF BRITISH INDIA (1875). However, it has been described in De Candolle's PRODROMUS SYSTEMATIS NATURALIS (1824), GENERA PLANTARUM of Bentham & Hooker (1876), INDEX KEWENSIS (1893), MANUAL FLORA OF EGYPT by Muschler (1912), FLOWERING PLANTS OF AFRICA by Thonner (1915), and FLOWERING PLANTS OF ANGLO-EGYPTIAN SUDAN by Andrews (1950). According to these authors three species of *Schouwia*, all natives of Arabia, occur in south and north Africa and the desert regions, bordering the Red Sea.

This plant was first located at Indapur, district Poona, in Maharashtra State, by Dr. M. B. Ghatge, Director of Agriculture, M.S., in 1961. It was identified by Dr. A. S. Rao of the Botanical Survey of India, Western Circle, Poona, and was confirmed by the Director, Royal Botanic Gardens, Kew.

With a view to observe the distribution of this plant, the eastern part of Poona district was surveyed in 1962. It was found that the plant grows profusely in Dhond and Indapur talukas on light sandy soils as well as in low-lying areas. The soils are absolutely dry from January to March when the plants flower and produce fruits. It often grows in cultivated lands, frequently infesting the entire fields. Cultivators of these areas report that they have been observing this plant every season for the last 15 years. This plant is rare at Yevat, frequent at Patas and Kedgaon, common at Dhond and Bhigwan, and abundant at Sakhargaon and Indapur.

ACKNOWLEDGEMENTS

My sincere thanks are due to Dr. A. S. Rao, Botanical Survey of India, Western Circle, Poona, for identification and to Prof. V. D. Vartak of Fergusson College, Poona, for the description.

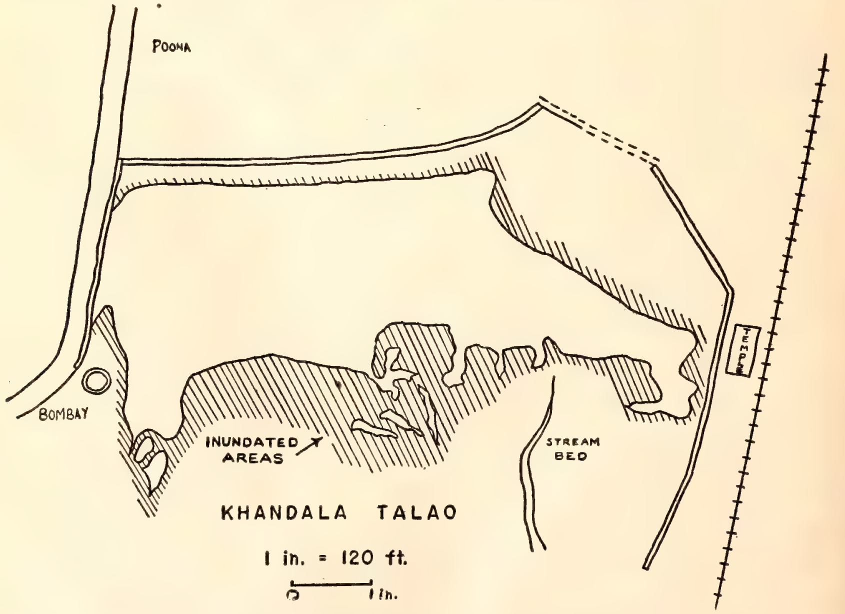
BOTANY DIVISION,
COLLEGE OF AGRICULTURE,
POONA 5,
July 20, 1962.

M. V. THOMBRE

21. THE AQUATIC PLANTS OF THE KHANDALA TALAO

(*With a sketch*)

In his paper presented to the symposium of the Indian Botanical Society at the 1955 Indian Science Congress (summary published in 1957) H. R. Ladwa reviewed the literature pertinent to the aquatic and marsh flora of the freshwater tanks of India. He stressed the need for intensive study of the permanent tanks, since they represent an interesting habitat with their seasonal changes in water level. Seasonal changes in the water content of small ponds also occur in



Sketch showing the Khandala talao

other countries, e.g. Byars (1959) studied the fauna and flora of a small, young New Zealand pond which fluctuated in area from *c.* $\frac{1}{3}$ to 1 acre depending on the season.

The talao at Khandala although very small does exhibit seasonal changes and, since it is easy to reach as well as being in an area which is well known floristically, it was felt that a detailed study of the talao would be of some value. The talao is in the centre of Khandala village in Maharashtra State. The Bombay-Poona road passes through the village and along the north side of the talao.

Biotic factors affecting the talao are present in two main forms: the local people, who uproot many of the 'kamal' plants (*Nymphaea pubescens* Willd.) for food and medicinal use, and animals which graze the slopes of the talao. The uprooting of kamal takes place mostly in the shallow water of the southern end and the grazing is usually restricted to the grassy areas on the west slope, above the water edge.

The water area and level increase during the monsoon, so that the gentle grassy slope on the western side is inundated. The water retreats with the approach of the dry season, and normally (most of the year) maintains an area of *c.* 1$\frac{1}{2}$ acres and a depth of 1-4 ft. New aquatic plant growth starts toward the end of the monsoon, but does not reach a maximum until the water recedes to the normal. At the height of the monsoon the water of the talao flows over the eastern retaining wall and the overflow drains off rapidly. The water in the talao is supplied mainly by a stream which flows from the hills west of the talao during the monsoon and for a short while afterward. Eventually the stream dries up. The other three sides of the talao are faced by retaining walls (see sketch). The water is not used at all for irrigation or for drinking and the talao never dries up even at the height of the dry season. In the north-west corner by the road is a large well made of stone blocks which contains a dense growth of *Ceratophyllum demersum* L. No stagnation seemed to occur in the well and it is said to have been used for water supply many years ago. The shallow areas around the talao contain water from the depth of a few inches to almost a foot in some areas; however, the shore drops off sharply to a depth of 3 feet and attains a maximum of 4 feet in the centre, the deepest part being the area against the north wall. Along the eastern side a narrow, steep embankment exists between the wall and the water's edge, and a wider, more gradual slope is present at the southern end.

I visited the talao during January, February, and April of 1960 after the monsoon and observed the plant associations in the water and those appearing on the moist soil left by the retreating water.

All of the plants described here can be found in Santapau's work (1953) with the exception of *Marsilea minuta* L., a common water fern, and *Naias minor* All., a common pond weed which seems to be a new plant in this area. The climate of the area is also recorded in Fr. Santapau's work and he informs me the talao is at least over 100 years old, as it is known to exist since the railway lines were laid in 1850.

Submerged plants. The bottom of the talao is entirely covered with a dense mass of *Ceratophyllum demersum*; it is the commonest plant in the water. The older plants were covered by diatom growth and attained a height of *c.* 2 feet. A large round mass of *Naias minor* appeared every yard or so and this plant grew up above the rootless *Ceratophyllum* 'carpet' so that the tops of the *Naias* plants reached just to the water surface. *Lagarosiphon alternifolius* was common in patches along the west shore with a few plants of *Blyxa octandra.* These plants were not affected most of the year except for the drying along the west shore. Dead dry plants could be found here and in areas higher up on the west slope.

Floating plants. Patches of *Hygroriza aristata,* a floating grass, were found in the shallow southern portion and these patches increased in size by February but later died back after fruiting. Those plants which became established near the shore flourished into April. None of the 'duckweeds' or floating ferns were seen and have not been reported in the area. Their absence indicates that the organic content of the water is not yet sufficient for their growth.

The water lily, *Nymphaea pubescens,* sprouts from turions stranded in the grassy mat along the west and south shores. These turions can also be found along with the dead remains of *Ceratophyllum* and seeds of *Limnanthemum* spp. high up on the west slope which is inundated during the wet phase (see Gaudet, 1960, for an account of the early growth of these *Nymphaea* turions). The *Nymphaea* spreads into water 3½ feet deep but does not grow in the deepest water along the north or east shore. As was mentioned earlier these plants are thinned out especially in the shallow areas by the local people. *Potamogeton indicus* is common among the *Nymphaea* as well as in shallow water and can even be found doing well on wet mud. In the water it reaches its peak in April. Two *Limnanthemum* species occur among the *Potamogeton* patches in the water and on wet mud, and although the two species are found growing close together, one species, *L. indicum,* is more often in deeper water. *Marsilea minuta* was found floating only in one patch near the south-east shore, but occurred on wet mud also.

Wet mud. On the west shore a large stand of the grass *Pseudoraphis aspera* covered the whole slope from the water edge to the drained soil higher up, except for some bare spots where the dry mud plants mentioned below were prevalent. Other wet mud plants often formed large stands on the west shore, e.g. *Limnophila indica* spread into patches of stranded *Potamogeton* and *Limnanthemum* plants. *Myriophyllum spathulatum* was also abundant here, but later in April it was dying off. On the south-east shore *Dysophila stellata* and *Salvia plebeia* did very well as long as the soil remained moist, but as drying continued they died off. These last plants spread along the east shore but they could not compete against a pure stand of *Polygonum glabrum* which thrived on the moist soil along this shore. The soil here is protected by the retaining wall.

Dry mud. On the mounds along the west side where the *Pseudoraphis* was absent, *Gnaphalium indicum* was the first plant to establish itself, along with a few individuals of *Mollugo oppositifolia.* Drying proceeded from the centre of the mounds and by February the plants on the crest of the mounds had died and the soil appeared dry, cracked and light-coloured. *Argemone mexicana* grew very well in and along the sides of the empty bed of the stream that drains surface run-off from the hills into the talao (see sketch).

The talao has been approaching old age for some time. Sediments washed from the surrounding hills and organic material from the decay of plant material, as well as that contributed by biotic factors, have caused the soft bottom now present in the talao. Since no earlier work is available for comparison, we can only surmise that the talao is much shallower at present. No doubt the flora of the talao is at a 'peak' in terms of the number of aquatic species present. The only new aquatics which could enter now would be of the 'duckweed' type. The talao flora resembles that of the Mugad tank described by Ladwa (1955). This is the oldest of the four near Dharwar studied by him and it has remained perennial for at least a century. It is quite large (97 acres) and deep, yet much organic matter is present and it contains the largest number of aquatic plant species compared to the other three.

If the Khandala talao were not subjected to such high grazing pressure, possibly *Polygonum glabrum* would be more prevalent along the shallow shores, but young seedlings are easily damaged by trampling. This plant is limited to a narrow protected bank along the east shore. As the bottom of the talao fills gradually through the years it would be interesting to follow the effect on the vegetation. At present the grassy slope seems to be encroaching along the west side where its new shoots are protected in the shallow water.

The talao will most likely become a marshy, grassy area in the future, and, since it is so small, this succession can be followed.

ACKNOWLEDGEMENTS

The author would like to thank the faculty and staff of the Botany Department of St. Xavier's College, Bombay, for their help and advice during the course of this and earlier work, which was done while the author was a Fulbright Scholar at the above institution.

LIST OF PLANTS IN AND AROUND THE TALAO

SUBMERGED

Ceratophyllum demersum L.
Naias minor All.
Lagarosiphon alternifolius (Roxb.) Druce[1]
Blyxa octandra Planch.

FLOATING (non-rooted)

Hygroriza aristata (Roxb.) Nees

FLOATING (rooted)

Limnanthemum indicum (L.) Griseb.
Limnanthemum cristatum (Roxb.) Griseb.
Potamogeton indicus Roxb.
Nymphaea pubescens Willd.
Marsilea minuta L.

WET MUD

Myriophyllum spathulatum Blatt. & Hallb.
Alternanthera sessilis (L.) R. Br.
Pseudoraphis aspera (Koen.) Pilger
Limnophila indica (L.) Bruce
Polygonum glabrum Willd.
Hygrophila polysperma (Roxb.) Anders
Dysophylla stellata Benth.
Salvia plebeia R. Br.

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[1] The correct name of this plant is *Nechamandra alternifolia* (Roxb.) Thw.; the genus *Lagarosiphon* does not seem to occur in India. On the subject see Subramanyam & Balakrishnan in *Bull. bot. Surv. India* 3 : 23-24, 1962.—EDS.

DRY MUD

Alternanthera sessilis (L.) R. Br.
Mollugo oppositifolia L.
Gnaphalium indicum L.
Argemone mexicana L.
Physalis minima L.
Tithonia tagetiflora Desf.
Ageratum conyzoides L.
Cyperus eleusinoides Kunth
Polygonum plebeium R. Br.

DEPARTMENT OF BOTANY,
UNIVERSITY OF CALIFORNIA,
BERKELEY, CALIFORNIA, U.S.A.,
March 6, 1962.

JOHN J. GAUDET

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[A. L. Adams, M.D., in WANDERINGS OF A NATURALIST IN INDIA, THE EASTERN HIMALAYAS AND CASHMERE, pp. 30-31, 1867, writes of the Khandala talao at about the middle of the nineteenth century:

'. . . Kandala is a little highland paradise . . . I spent a delightful day toiling over these rugged ravines, and after a hard scramble at length gained the camp, and was reclining on my couch, when a soldier rushed into the tent, to inform me that one of his comrades was drowning in a pond close by, and no one could attempt to save him, in consequence of the dense weeds which covered the surface. On repairing to the spot, we found the poor fellow in his last struggle, manfully attempting to extricate himself from the meshes of rope-like grass that encircled his body; but, to all appearance, the more he laboured to escape, the more firmly they became coiled round his limbs. At last he sank, and the floating plants closed in, and left not a trace of the disaster. After some delay, a raft was made, and we put off to the spot, and sinking a pole some 12 feet, a native dived, holding on by the stake, and brought the body to the surface . . .'—EDS.]

22. NOMENCLATURAL NOTES ON SOME BOMBAY PLANTS—II

(*Continued from Vol.* **59**, *page* 322)

PAPILIONACEAE

(1) **Alysicarpus glumaceus** (Vahl) DC. Prod. 2 : 353, 1825; Andrews, Fl. Pl. Anglo-Egypt. Sudan 2 : 175, 1952. *Hedysarum glumaceum* Vahl, Symb. Bot. 2 : 106, 1791. *Hedysarum violaceum* Forsk. Fl. Aegypt.-Arab. 136, 1775 (non Linn. 1753). *Hedysarum rugosum* Willd. Sp. Pl. 3 (2) : 1172, 1803. *Alysicarpus violaceus* (Forsk.) Schindl. in Fedde, Repert. 21 : 13, 1925. *Alysicarpus rugosus* (Willd.) DC., Prodr. 2 : 353, 1825; Cooke 1 : 348.

The earliest basionym for the present plant is *Hedysarum violaceum* Forsk. (1775) and it should have been called *Alysicarpus violaceus* (Forsk.) Schindl.; however, Forskal's name cannot be taken up here, it being a later homonym to that of Linné (1753), which is *Lespedeza violacea*. Willdenow in Sp. Pl. 3 (2) : 1172, 1803 considers *Hedysarum violaceum* Forsk. and *Hedysarum glumaceum* Vahl conspecific. The next valid name, therefore, is *Hedysarum glumaceum* Vahl and the correct name for the present plant should be *A. glumaceus* (Vahl) DC. as adopted by Andrews.

(2) **Desmodium heterocarpum** (L.) DC. Prod. 2 : 337, 1825; Merrill in Trans. Amer. Phil. Soc. (N.S.) 24 : 200, 1935. *Hedysarum heterocarpon* Linn. Sp. Pl. 747, 1753. *Hedysarum polycarpon* Poir. in Lamk. Encycl. 6 : 413, 1804. *Desmodium polycarpum* (Poir.) DC. Prod. 2 : 334, 1825; Cooke 1 : 354.

This plant goes under the name *D. polycarpum* in our Indian floras; however, it must be called *D. heterocarpum*, based on *Hedysarum heterocarpon* Linn. 1753.

(3) **Indigofera spicata** Forsk., Fl. Aegypt.-Arab. 138, 1753; Gillett in Kew Bull. 1958 (Add. Ser. I) : 119. *Indigofera hendecaphylla* Jacq. Coll. Bot. 2 : 358, 1788; Cooke 1 : 314. *Indigofera endecaphylla* Jacq.; Lamk. Encycl. Suppl. 3 : 147, 1813 (per Sphalm); Baker in Hk. f. Fl. Brit. Ind. 2 : 98, 1876.

(4) **Tephrosia pumila** (Lamk.) Pers., Syn. 2 : 330, 1807; Prain, Beng. Pl. 406, 1903; Haines, Bot. Bih. & Oris. 2 : 242, 1921; Santapau, Fl. Saurashtra 1 : 137, 1962. *Galega pumila* Lamk. Encycl. 2 : 599, 1788. *Tephrosia purpurea* (L.) Pers. var. *pumila* (Pers.) Baker in Hk. f. Fl. Brit. Ind. 2 : 113, 1876; Cooke 1 : 325. *Tephrosia procumbens*

Buch.-Ham. in Trans. Linn. Soc. 13 : 54, 1822; Gamble, Fl. Madr. 320, 1915.

Baker, and following him Cooke, treated this plant as a variety of *T. purpurea*. Gamble raised it to specific rank as *T. procumbens*. Prain, Haines, and Santapau also treat it as a distinct species. The prostrate habit, 1-3-flowered inflorescence and the overall small size of all its parts make it quite distinct from *T. purpurea*; in our opinion it deserves specific rank and we agree with Prain, Haines, and Santapau in calling our plant *T. pumila*.

(5) **Vigna unguiculata** (Linn.) Walp. Repert. 1 : 779, 1842; Andrews, Fl. Pl. Anglo-Egypt. Sudan 2 : 246, 1952. *Dolichos unguiculatus* Linn. Sp. Pl. 725, 1753. *Dolichos sinensis* Linn. Cent. Pl. 2 : 28 1756. *Vigna catjang* Walp. in Linnaea 13 : 533, 1839; Cooke 1 : 380. *Vigna sinensis* (L.) Savi ex Hassk. Cat. Hort. Bogor. 279, 1844. *Vigna catjang* var. *sinensis* Prain, Beng. Pl. 389, 1903.

Merrill (*Enum. Phil. Fl. Pl.* 2 : 320, 1923), Bailey (*Man. Cult. Pl.* 576, 1949). and Santapau (*Rec. Bot. Surv. Ind.* 16 (1) : 80, 1953) name this plant *V. sinensis* (L.) Savi ex Hassk.; on the authority of Andrews the correct name should be *V. unguiculata* (L.) Walp., based on *Dolichos unguiculatus* L. 1753.

MIMOSACEAE

(6) **Neptunia prostrata** (Lamk.) Baill. in Bull. Soc. Linn. Par. 1: 356, 1883. *Mimosa prostrata* Lamk. Encycl. 1:10, 1783. *Neptunia oleracea* Lour. Fl. Cochinch. 654, 1790; Cooke 1 : 435.

EUPHORBIACEAE

(7) **Manihot esculenta** Crantz, Inst. Rei Herb. 1 : 167, 1766; Andrews, Fl. Pl. Anglo-Egypt. Sudan 2 : 86, 1952. *Jatropha manihot* Linn. Sp. Pl. 1007, 1753. *Manihot utilissima* Pohl, Pl. Bras. Icon. 1 : 32, t. 24, 1827; Cooke 2 : 627.

(8) **Baliospermum montanum** (Willd.) Muell.-Arg. in DC. Prod. 15 (2) : 1125, 1866; Hoffm. in Pfreich. 63 : 208, 1914. *Jatropha montana* Willd. Sp. Pl. 4 : 563, 1805. *Baliospermum axillare* Bl. Bijdr. 604, 1825; Cooke 2 : 608.

CYPERACEAE

(9) **Eleocharis acutangula** (Roxb.) Schult. in R. & S. Syst. Veg. Mant. 2 : 91, 1824; Andrews, Fl. Pl. Sudan 3 : 359, 1960. *Scirpus*

fistulosus Poir. Encycl. 6 : 749, 1806 (non Forsk. 1775). *Scirpus acutangulus* Roxb. Fl. Ind. 1 : 213, 1820. *Eleocharis fistulosa* Link ex Spreng. Jahrb. Gewäch. 3 : 78, 1820; Cooke 2 : 888.

(10) **Eleocharis dulcis** (Burm. f.) Trin. ex Henschel, Vita Rumph. 186, 1833; Blake in Journ. Arn. Arbor. 28 : 227, 1947. *Andropogon dulce* Burm. f. Fl. Ind. 219, 1768. *Scirpus plantagineus* Retz. Obs. 5 : 14, 1789. *Eleocharis plantaginea* (Retz.) R. & S. Syst. 2 : 150, 1817; Cooke 2 : 888.

The name *E. dulcis* Trin. ex Henschel is accepted here on the authority of Blake (1947), based on *Andropogon dulce* Burm. f. Burmann in Fl. Ind. describes the present plant 'Spica solitaria, imbricata, flosculis muticis. Habitat in India', and refers to *Cyperus dulcis* Rumph. Herb. Amb. 6 : 7, t. 3, f. 1, 1750. I have not been able to check the later reference.

(11) **Fimbristylis falcata** (Vahl) Kunth, Enum. Pl. 2 : 239, 1837; Kern in Blumea 8 (1) : 113, 1955. *Scirpus falcatus* Vahl, Enum. Pl. 2 : 275, 1806. *Trichelostylis junciformis* Nees in Wt. Contrib. Bot. Ind. 106, 1834. *Fimbristylis junciformis* (Nees) Kunth, Enum. Pl. 2: 239, 1837; Cooke 2 : 886.

ST. XAVIER'S COLLEGE,
BOMBAY 1,
January 8, 1963.

G. L. SHAH, M.SC., Ph.D.

Notes and News

RINGING OF FLAMINGOS AT LAKE MAGADI, KENYA COLONY

As a result of a co-operative effort by the East African Natural History Society, the British Museum, and the Africana Flamingo Fund, 8000 young Lesser Flamingos (*Phoeniconaias minor*) and 80 young Greater Flamingos (*Phoenicopterus ruber*) were ringed at Lake Magadi, Kenya Colony, in 1962. The rings used were 16 mm. monel rings, attached above the tibio-tarsal joint. Should anyone find a ringed flamingo, or even only the ring, the ring should be returned to the Bird Ringing Committee, British Museum (Natural History), Cromwell Road, London S.W. 7, with details of the locality and date. Although the British Museum will be co-ordinating all recoveries, the East African Natural History Society will be most interested to hear of the find, and the finder should send details of the ring number, date, and locality to the Ringing Committee, East African Natural History Society, Coryndon Museum, Nairobi. The ring itself should be returned to the British Museum.

Finders in India, if any, may communicate with the Honorary Secretary, Bombay Natural History Society, 91 Walkeshwar Road, Bombay 6-WB, who will be glad to arrange for the transmission of the ring to the British Museum (Natural History).

* * * *

XIV INTERNATIONAL ORNITHOLOGICAL CONGRESS

The XIV International Ornithological Congress will be held at Oxford in Great Britain in July 1966 with Dr. David Lack as President. Dr. N. Tinbergen has been elected as Secretary-General and a British Executive Committee has been formed. If it proves practicable, one excursion will be organised—a week's cruise of Scottish sea-bird islands in a ship of sufficient size to accommodate most members of the Congress. The provisional dates are: 16-23 July 1966 for the cruise, and 24-30 July for the meeting in Oxford.

The British Executive Committee gratefully acknowledges $200 received from the American Ornithologists' Union. If other countries wish to contribute, cheques should be sent to the Treasurer (Mr. A. G. S. Bryson), 7 Forres Street, Edinburgh 3.

* * * *

EAST AFRICAN WILD LIFE JOURNAL

The East African Wild Life Society is producing a Journal for the publication of scientific papers and research notes relating to all aspects of wild life. The contents, although primarily based on observations and research in East Africa, will not be limited to this region. Initially the Journal will be published yearly; it will cost 15*s.* within East Africa and 17*s.* 6*d.* (U.S. dollars 2.50) elsewhere, inclusive of postage and packing. The first issue will appear on September 1st, 1963, and will include papers by L. H. Brown (Birds of prey), H. F. Lamprey (The Ecological Separation of East African Mammals), D. L. W. Sheldrick and P. Napier Bax (Food Plants of Elephants), J. Glover (The Elephant Problem in Tsavo), J. Procter (Spotted-Necked Otters), A. Ritchie (The Black Rhinoceros), H. P. Ledger (Carcase analysis), and D. R. M. Stewart (The Arabian Oryx). Mrs. Elspeth Huxley, the well-known writer on East African affairs and supporter of wild life conservation, will contribute an introductory article.

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Editors
H. SANTAPAU, S.J., & ZAFAR FUTEHALLY

AUGUST 1963

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JOURNAL
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1963 AUGUST Vol. 60 No. 2

The Biology of the Eastern Spanish Sparrow, *Passer hispaniolensis transcaspicus* Tschusi, in Kazakhstan[1]

BY

E. I. GAVRILOV
Institute of Plant Protection, Alma-Ata, U.S.S.R.

(*With three plates*)

The study of the bionomics of different species of birds has not received sufficient attention till recently. This is true not only about rare birds, but also about common ones which have a world-wide distribution. For example ornithologists have so far paid very little attention to the sparrows, although some species of sparrows have a very important economic significance. For a long time in central Asia and in south Kazakhstan they have been serious pests to the farmers. But apart from this some of them are very sociable birds and it is especially interesting to study their communal life.

During three years the author studied the biology of sparrows. He tried out the earlier methods of controlling their numbers and tested new methods. This work was performed under the guidance of Professor I. A. Dolgushin, Doctor of Biological Sciences.

The Eastern Spanish Sparrow, *Passer hispaniolensis transcaspicus* Tschusi, is the most numerous among our sparrows. It is distributed in Kazakhstan from the administrative frontier at the south, northward as far as the valleys of the rivers Sir-Daria and Chu. It is also found in the lowlands adjoining the Kirgizsky, Zailyisky, and Dzungarsky Ala-Tau, north to Lake Alakoul.

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[1] Communicated by Dr. Sálim Ali.

The observations of the last few years show that this species is rapidly colonizing new areas. In the first forty years of this century the north-eastern boundary of its range lay along the river Karatal and in the valley of Ili river near the town of Panfilov (Shnitnikov, 1949). Development of extensive forest plantations and agriculture since then has provided the sparrow with excellent living conditions. Taking advantage of these the bird has spread right up to Lake Alakoul where it was found in 1959.

Simultaneously with the extension of its range, the Eastern Spanish Sparrow increased in numbers. According to the observations of I. A. Dolgushin (personal information) the bird was not found near the village Ilyisk in 1931, 1932, and 1933. The first birds were obtained by him there in 1934, and they were then considered to be extremely rare in this region. But already by 1949-50 the Spanish Sparrows had become the most numerous among the sparrows in this place.

Meanwhile the numbers of the Indian Sparrow (*Passer domesticus bactrianus* Zar. et Kudasch.)[1] dropped. Apparently, the Spanish Sparrow, being larger, more aggressive, and more communal, forced the Indian Sparrow out from the forest plantations. The latter has now taken to nesting in villages, and in holes in precipices, etc.

The Spanish Sparrow nests almost exclusively in cultivated areas, living in the proximity of man. The availability of grain crops is one of the necessary conditions for these birds, and they seldom nest at any distance from cultivation. However, Spanish Sparrows usually nest away from actual human settlements, and only occasionally within villages and the outskirts of small towns. But the bird readily follows in the wake of cultivation, and has reached 500 to 600 m. above sea-level in the Zailyisky Ala-Tau mountains, and in places even up to 1370 m.

It is a migratory bird. Its winter range chiefly comprises northern Africa, Palestine, Iraq, Iran, Baluchistan, north-western India, and Sintzian. In the Soviet Union it winters in large numbers in Turkmenia. It may also be found in winter in Tadjikistan, Kirgizia, along the northern outskirts of the Kisil-Kum desert, in the valley of the river Sir-Daria. In winter 1954-55 it was observed in small numbers in the delta of the river Ili (Gratchev, 1960).

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[1] Considered by some authors to be synonymous with both *parkini* and *griseigularis*; by others to be separable from *parkini*.—S. A.

The birds probably start the return flight from their winter quarters about the beginning of March, as the spring migration takes place in northern India from the second week of March to the middle of April (Whitehead, 1909). They come to Kazakhstan at the end of April, or in May. Their mass arrival is observed, usually, in the middle or end of May.

During their migration the birds keep mainly to open biotope, preferring areas with bushes, especially thorny ones, which are favourite places of rest for all sparrows. They fly in flocks of 5-10 to 150-300 individuals, which consist, as a rule, exclusively of birds of their own species, only rarely mixed with a few Indian Sparrows. It is typical of the flocks to fly along open highways if running in the proper direction. The spring passage occupies a long overall period. In 1959, near the village Nikolaevka, the sparrows were flying in from the end of April till the first days of June. The first to arrive are the males, beginning with a few individuals and then in small flocks. Later, at the period of mass flight, the flocks of males contain a small number of females; while in the last flocks the females predominate.

The Spanish Sparrow nests as a rule in large colonies. Commonly the colonies are of 20-30 thousand nests, and sometimes they consist of 100 thousand or even 800 thousand nests. The smaller colonies of sparrows are found mainly in the north-eastern region of its range. For example, in the Alma-Atinsky region in 1959 along the river Karatal and near the village Uch-Aral their colonies consisted of 200-5000 nests (average 1700) and near the villages Ilyisk and Chilik of 500-25,000 nests (average 10,000). In 1961, in the neighbourhood of the villages Chokpar and Krasnogorka they consisted of 7500-90,000 nests (average 31,000); in 1962 in the Kurdaisky district of the Djambul region, of 300-800,000 nests (average 42,500). One hectare of forest plantation contained an average of about 13,000 nests.

We observed two types of sparrow colonies. The first type is situated in gardens, groves, and small forest plantations, within a distance of a few hundred metres. Such places are usually settled by the sparrows in 1-2 days. The colonies of the second type are situated in forest plantations stretching very often over several kilometres. Here, side by side with areas of dense settlement, are areas with a small sparse settlement or completely unoccupied. In such colonies, the sparrows first build in the central parts, which still have many of the last year's nests, and it is only afterwards that they occupy the outer areas with fewer nests.

During the establishment of a colony, incoming flocks give first preference to trees already occupied by other sparrows. If all the suitable places are occupied, the newcomers are forced out by the males guarding their territories. The birds have then to resort to neighbouring trees with either very few nests or none at all. Thus in the well-established colonies the number of nests on each tree remains more or less constant from year to year.

It is interesting to note that wherever there is room for two or more nests the males may sit side by side to attract the females. If in the forked crown there is room for only one nest, the 'owner' forces out each intruder.

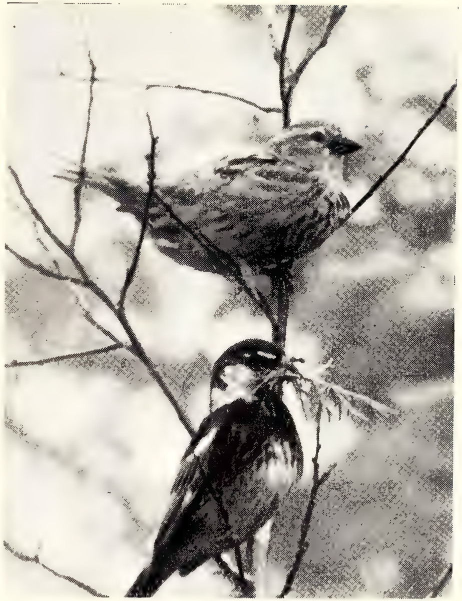
In contrast with many colonial birds which return for breeding to the same place year after year, the Spanish Sparrows prove not to be constant to particular nesting sites. Often without apparent reason the birds will not settle in the forest plantations where they nested during previous years, and will organize their colonies in new places. This might be explained by the change in the number of sparrows and by their attempt to occupy a more suitable area from the beginning. In any region they always settle first in forest plantations, which are the most convenient for them, and afterwards, as their number increases, they occupy other places less suitable for reproduction. On the other hand the primarily settled places may be deserted.

By means of ringing it was found that in 1961 among the sparrows near the village of Chokpar only 11% of the birds were 'local', i.e. bred here in the previous year, while 89% of the birds were 'new arrivals' from some other regions. In 1962 in the same region these figures were changed to 5 and 95% respectively (in 1961 and 1962 there was mass extermination of the sparrows here).

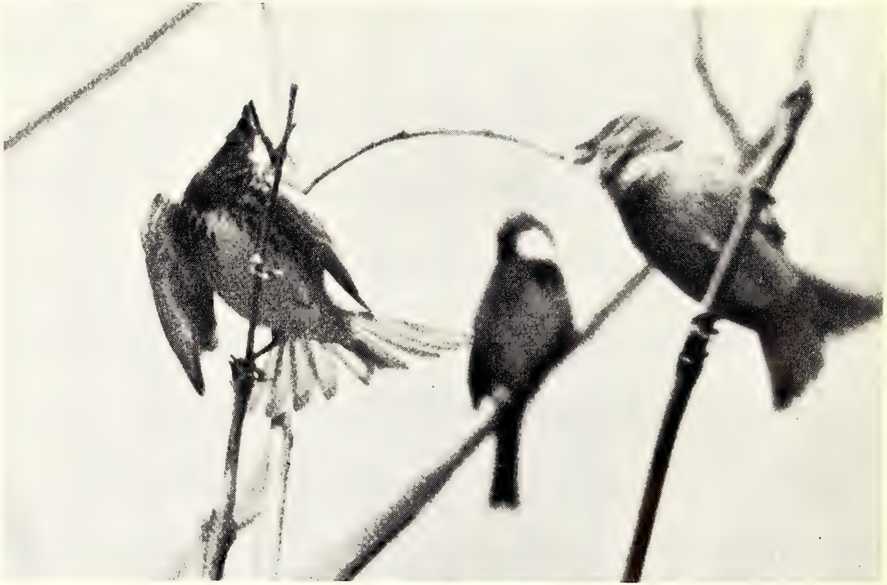
The data obtained by us confirmed the wide exchange of birds between different populations. This circumstance may be responsible for the intensive settling of the Spanish Sparrows in new places. It may also explain the extremely weak development of nest-conservatism and the lack of constancy to their nesting places.

The establishment of the Spanish Sparrow colonies usually happens a few days after the beginning of the mass arrivals, and even in the same region the colonies are not occupied simultaneously. The first to be occupied are those mixed colonies which are situated in the neighbourhood of villages, in which there are a considerable number of House Sparrows as well as Spanish Sparrows. House Sparrows uttering their mating-call may already be observed here by the middle

PLATE I

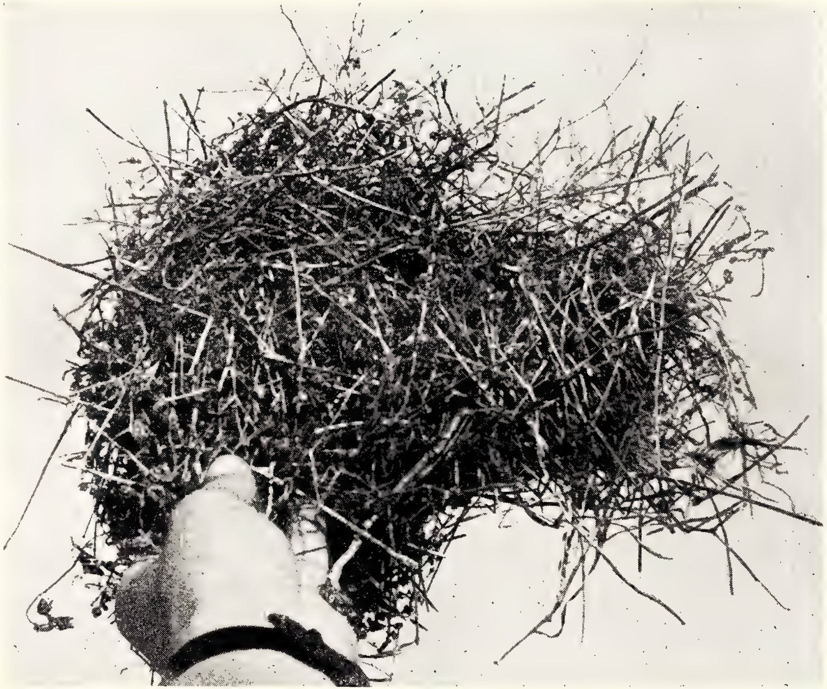


1. A male (with grass blade) and his hen

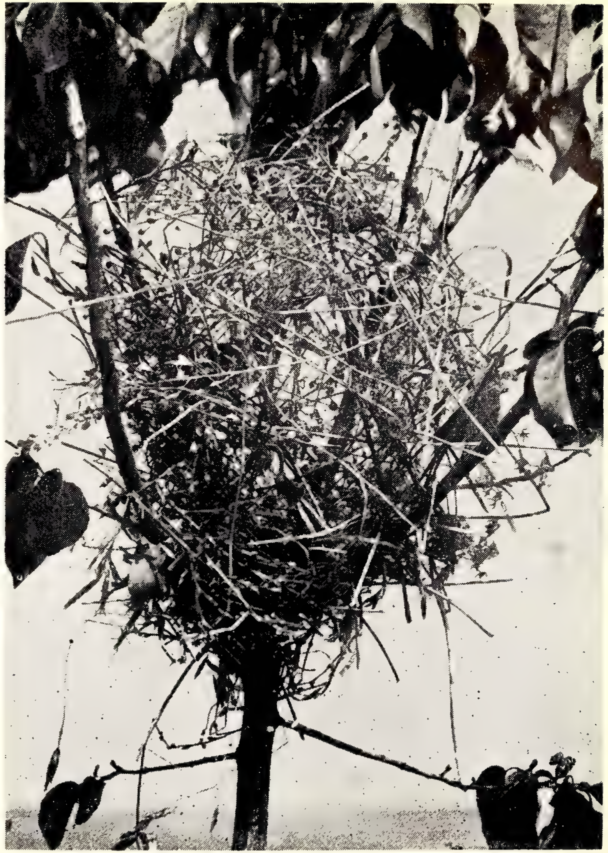


2. A displaying male

(*Photos : E. Gavrilov*)



3. A completed nest (side view)



4. Early stage of nest: a ball-shaped openwork structure

(*Photos : E. Gavrilov*)

of April. Probably this attracts the Spanish Sparrows, which first begin establishing their colonies in such areas.

Some colonies which consist exclusively of Spanish Sparrows start establishing 7-28 days later, when the first-settled birds have already hatched their chicks.

The Spanish Sparrow nests in Kazakhstan in different forest plantations (Fig. 5 and 6). It is a marked fact that the birds gravitate towards that species of tree, the branching of which facilitates nest construction. The sparrows' nests are situated in the greatest density on Lombardy Poplars (more than one hundred on a single tree), then to a diminishing degree on Oleasters (*Elaegnus angustifolia* L.), False Acacias (*Robinia pseudoacacia* L.), Ashenleaf Maples (*Acer negundo* L.), other poplars, and Cork Elm (*Ulmus campestris* L.). They also make their nests on fruit trees, and in exceptional cases even on Huntingdon Willows.

Depending on the character of the branching of the trees, the nests may be situated alone, or one below another like a garland, or they may be built surrounding a stem. There may be anything from 1-5 to 120-130 nests on one tree. The height of the nest depends as a rule on the species and age of the tree. In young forest plantations they were found at a height of 50 cm. on Oleaster, whereas on Lombardy Poplars the nests may be built at the top, about 25-30 m. high.

The vanguard of males usually occupy last year's nests or even older ones which are sometimes merely semi-putrefied heaps of grass. Occasionally, but not often, the birds choose some forked crown, where they bring ten or more blades of grass to make the apron.

After choosing the site for his future nest the male, by means of a strenuous twittering, begins to attract a female (Fig. 2). The twittering of thousands of sparrows makes such a deafening noise that it is often difficult to converse in a colony.

When the females fly in they carefully observe the sites for the nests, but pay little attention to the males uttering their mating-call with so much enthusiasm. Later, each female chooses one of them. After pair formation the male begins the intensive repair of an old nest or works on a new one. He does the main work, bringing the building material and laying it in its place. At this period the female helps very little, but later she lines the nest herself.

The nest is made exclusively of green grass, which is collected by the birds themselves (Fig. 1). They use a lot of mown grass. At some places where a field of lucerne, which is first cut in May, is situated near a colony of sparrows, the birds bring in many tons of the newly cut grass. Often it was observed that the males made attempts to steal one another's material for their own nests. The nest is lined with small pieces of wormwood, with leaves of acacia, and so on, and only occasionally with a few feathers. This is the sign by which Spanish Sparrows' nests may be differentiated from those of House, Indian, and Tree Sparrows which always have a large amount of feather lining.

The building of the nest is carried out in the following way: at first the apron is made from the stems of grasses and thin branches, then the walls and the roof are built from the same material. At the end of the second day the nest has the appearance of a ball-shaped openwork structure (Fig. 4). At the time of egg-laying the nest looks like a globe with thick walls and a lateral entrance. During the period of egg-laying, and in the first days of incubation, the male prolongs his activity by making the lateral tubular entrance—the antechamber of the nest.

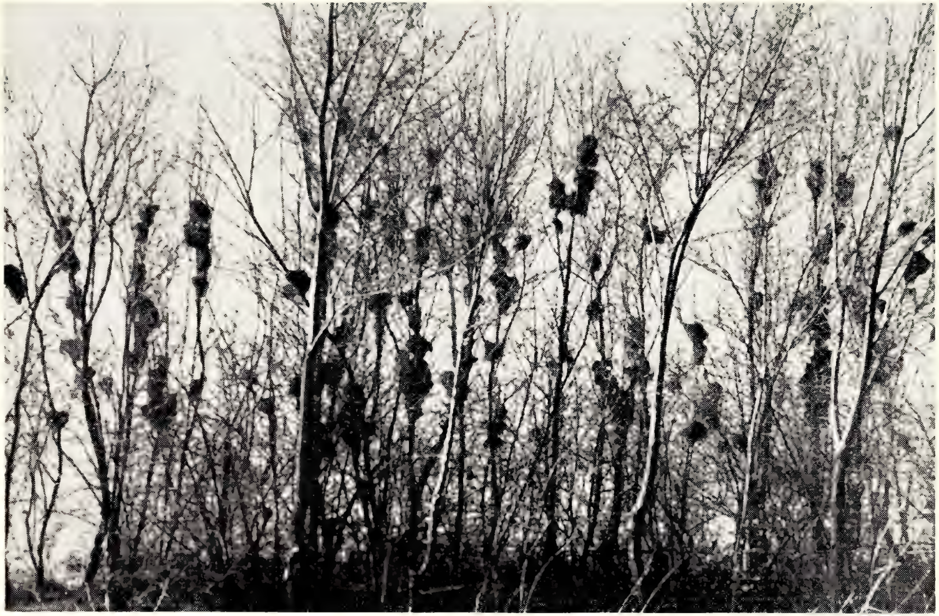
Where the lack of branches does not allow it to make the openwork foundation of the nest, or if the bird uses the cut lucerne as building material, the nest is made in another manner. After building the apron of the nest the sparrow begins to build its thick walls, leaving a place for the lateral entrance. Thereafter it makes the roof, and last of all the antechamber. The finished nest represents a ball-shaped or oval structure with a diameter of 20-30 cm., with a lateral entrance which projects like a small tube (Fig. 3). The weight of the nests is from 70 to 300 gm. (average 150).

The building of the nest takes 4 or 5 to 7 days (Achmetov, 1953; Umrichina, 1955). The sparrows that come later complete their nests in a shorter time than those that arrive and start earlier.

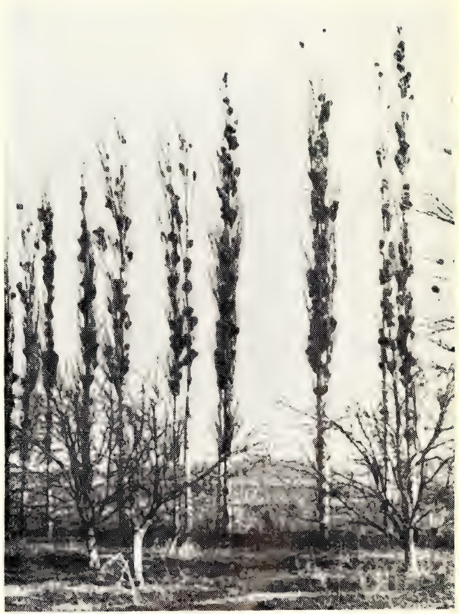
The sparrows begin laying before the building of the nest is completed. This may be especially observed in colonies which are rather late in settling. The females come here with well-developed gonads and the first eggs may be laid during the flight, while on passage to their nesting place. Every morning the female lays one egg. As may be seen from Table I, the full complement is of 2-7 eggs, but usually 4-5 eggs, with an average of 4.4. The egg measurements, taken with a vernier calliper, are given in Table II.

Abnormal (pigmy) eggs, lacking the yolk, were found twice. One of them measured 11.6×10.6 mm. and weighed 0.67 gr. It was the first of the clutch, the other five eggs of the same female being normal.

The number of the laid eggs in some birds, for example in the



5. Part of sparrow nest colony in roadside forest belt



6. Part of sparrow nest colony in garden protecting forest belt

(*Photos : E. Gavrilov*)

Starling (*Sturnus vulgaris* L.), does not correspond to the ova ovulated (Davis, 1958). We examined the state of the ovaries of 19 Spanish Sparrows and the contents of their nests. It was found that only 4 females had the same number of eggs in the nest as the ovulated ova, and the clutches of the others were 1, 2, 3, 4, and 5 less than the broken follicles. The latter two cases represented an exact replacement of the first clutch by a second one; in the other cases the extra eggs laid were probably lost.

TABLE I

CLUTCH-SIZE OF THE SPANISH SPARROW
(according to the data obtained in 1959-61)

Number of eggs	2	3	4	5	6	7	Total nests examined
No. of nests in which found ..	22	124	399	493	59	2	1099
% of nests examined..	2.0	11.3	36.3	44.8	5.4	0.2	100%

TABLE II

EGG MEASUREMENTS OF THE SPANISH SPARROW

	Min.	Max.	Mean with standard deviation	Quadratic deviation	Number measured
Length in mm. ..	18.0	25.7	21.93 ± 0.0712	± 1.1111	244
Width in mm. ..	13.7	16.6	15.29 ± 0.0346	± 0.5395	244
Shape width/length..	0.55	0.81	0·70 ± 0.0032	± 0.0505	244
Weight in gr. ..	1.62	3.47	2.63 ± 0.0156	± 0.2460	248

In some species of birds there is possibility of producing more eggs than is typical for the species (indeterminate laying). A. E. Brehm (1911) cites the observations of Rey, who took one egg from nests of House Sparrows every day and in such circumstances the females laid up to 49 eggs in succession. The same experiment was performed by us on 11 females of the Spanish Sparrow. After the first egg was laid, every time another egg was laid one of the two eggs was removed so that there was always only one egg left in the nest. It became clear that this species is a determinate layer and that the number of eggs could not be increased in this manner. Each of the 11 birds laid 3-6 eggs (average 4.5) and then stopped. By examining 172 nests in this colony it was ascertained that the average clutch-size of Spanish Sparrows was about 4.5 eggs.

The egg-laying in a colony is usually completed within a short period. In three colonies, when only the Spanish Sparrows were nesting, by the 5th day after the appearance of the first egg in the nests, 75, 80, and 89% of all the birds began their laying. In this case nestlings also developed rapidly and the colonies very soon became disinhabited, more or less synchronously.

Many authors have stated that the same colony of sparrows may contain nestlings of different ages and eggs at different stages of incubation. Our material confirms this; this condition is usually observed in mixed colonies where different species of sparrows, including House Sparrows, which have several broods in a year, nest together. Thus such colonies have nesting sparrows during the whole summer. If the Spanish Sparrows lose the first clutch for some reason, or if any one of the parents dies, the birds join these mixed colonies for reproduction. Besides, some of the birds normally nest twice a year.

In the incubation, which starts after the second egg is laid, both parents take part, although the female's is the major share. At night only females have been found on the nests. The males gather in large flocks at night and roost in leafy trees, often at a considerable distance from their nests.

After an incubation period of 11-14 days the blind naked nestlings are hatched. Both parents bring them up. While catching the sparrows at night we made an interesting observation. It was found that the female parent, which was frightened off her nest, returned after some time in spite of the total darkness. One female returned to the nestlings twice, and it was possible to catch her only at the third attempt.

It is quite obvious that the sparrows cannot orientate themselves well in darkness. When the birds were released after the ringing they fell down and it was only after some time that they could fly up[1]. On reaching the tops of the trees they alighted on the first branch. It is possible that in locating their nests at night the sparrows orientate themselves by means of the 'muscle feeling', [echo-location ?], based on the filmostatic memory, in the same way as Oilbirds (*Steatornis*) and *Collocalia* swiftlets nesting in dark caves, which unerringly find their own nests from among numerous others (Dementiev, 1940).

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[1] From similar experience with Spanish Sparrows during the BNHS/WHO bird ringing field camps in Rajasthan, it is suggested that this seeming helplessness in the dark may be due only to the birds becoming temporarily blinded by the bright electric light under which the ringing was done. The birds at first used to flop to the ground immediately on being released but, later, when set down gently on a platform away from the light, they soon recovered their sight and flew off strongly into the darkness.—S.A.

Ordinarily 1-2 of the younger nestlings, who are behind the others in growth, perish. On an average 2-3 nestlings fly from each nest. The chicks leave the nest after 11-12 days.

As already mentioned, the egg-laying in many colonies is performed rapidly and synchronously. In consequence of this all other stages of breeding, including hatching and flying of young from the nests, are also synchronized. It is interesting that each of the three stages—egg-laying, incubation, and the nestling period —covers a period of about 9×24 hours.

After their first flight from the nest the fledglings live in the colony where they are fed by the parents. At night they usually fly to their nests, sometimes to another's, where there are other chicks too. Some of the fledglings spend the night on trees with the adults.

After becoming fully fledged, the young leave the colony, bunch into flocks consisting sometimes of a few thousand birds, and start the migratory life. All the time the flocks are augmented by young ones from later broods. Sometimes these flocks are joined by juveniles with imperfectly developed flight feathers and still dependent on the parents for food. The absence of adult birds in these flocks, except for the few individuals that are tending such immature juveniles, is characteristic. About one month after leaving the nests the young sparrows begin to shed the first feathers and gradually moult into adult plumage.

It was observed that in the juveniles of the Spanish Sparrow before the moult, when the sex of the birds cannot be determined superficially, or just at commencement of the post-juvenile moult, the flocks tend to split up sex-wise. In 1961 on July 4-9 from each of 26 flocks near the village Chokpar 5-11 birds were collected. In 13 flocks, males predominated (91% of 105 sparrows), and in the other 13 flocks, females (90% of 98 sparrows). Only males were obtained from 6 flocks of which 48 birds were collected; and only females from 4 flocks of which 31 birds were collected. It is in such sex-segregated flocks that the sparrows apparently spend the time left till their departure in autumn, and also during migration.

In this interval the adult sparrows either re-nest or raise second broods, or gather in flocks and in the middle of June or in July are flying for the moult. Probably for the completion of the post-nuptial moult the birds gather in some other region, since all adult sparrows obtained by us in August were only just beginning the moult, and in spite of careful searching none were found in subsequent stages of moult in this region.

Only a few of the sparrows which are the first to arrive, at the beginning of May, nest twice a year; the rest only breed once. The possibility of re-nesting keeps all birds there rather a long time. And in case of accidents, either to the clutch or the nestlings, they readily breed again. Thus it is that the destruction of nests alone has little effect in the campaign for reducing sparrow numbers.

During the autumn migrations the birds confine themselves to corn fields and thickets of weeds. They are partial to the fields of late ripening millet and hemp, where they collect in masses causing great damage to the crops.

The departure of adult Spanish Sparrows from Alma-Atinskaya and Dzambulskaya regions takes place immediately after breeding is over. In 1961 the passage near the village Chokpar was observed from June 13th on, and it became especially intensive at the beginning of July. Young birds leave considerably later than the adults, and probably all the late meetings with the Spanish Sparrow in Kazakhstan concern young birds. Normally they emigrate in September-October; a few stray birds stay behind up to the middle of November.

Fecundity. It is well known that not all laid eggs are fertile. The number of infertile eggs in the clutches of the Spanish Sparrow is not large. In 1959-1961 such eggs were found in 95 (17.6%) out of 537 nests examined, and represented 4.9% of the total number of eggs. The loss of embryos during the incubation period is also not heavy. In 1959-1961 dead embryos were found in 23 (4.2%) out of the 537 nests inspected, and represented 1.2% of the total number of eggs. Thus the joint loss from both these causes during 3 years was 6.1% of the total number of eggs. Observation at 75 nests in 1960 showed that 95.1% of the eggs hatched.

But the loss of nestlings in Spanish Sparrows is considerable. It is only in a few cases that all the nestlings leave the nest as fledglings. Ordinarily 1-2 of the younger and weaker nestlings die.

The number of chicks which reach the flying stage is in direct ratio to the clutch-size: as more eggs are laid so, on the average, more fledglings leave the nest (Table III).

TABLE III

NUMBER OF NESTLINGS THAT FLEW IN RELATION TO CLUTCH-SIZE
(In the colony near the village Chokpar, 1960)

Clutch-size	No. of young that flew					Average for one nest
	1	2	3	4	5	
2 ..	1	1	—	—	—	1.5
3 ..	—	2	—	—	—	2.0
4 ..	3	9	7	7	—	2.69
5 ..	6	17	15	17	—	2.78
6 ..	—	2	2	2	1	3.3
Total of data ..	10	31	24	26	1	92 \ 2.77

The loss of nestlings is higher in the larger clutches. If in the clutch of 2 eggs an average of 75% reach the flying stage, so in the clutch of 3 eggs—66%, of 4 eggs—67%, of 5 eggs—55% and of 6 eggs—54%. According to the observations at the 290 nests in 1959-1961 the average number of Spanish Sparrow nestlings which left the nest was 2.54 per breeding pair of adult birds.

In 1960, in the colony near the village Chokpar, there were 100 nests the building of which had just begun. They were examined regularly every second day. The results are contained in Table IV.

TABLE IV

NESTING SUCCESS OF THE SPANISH SPARROW

Fate of nests	No. of cases
1. Nest deserted before egg-laying began ..	11
2. Nest deserted before egg-laying finished ..	6
3. Nest deserted after egg-laying finished ..	8
4. Nest with eggs fell off tree ..	2
5. Nest destroyed (by man ?) ..	18
6. All nestlings died ..	4
7. Nestlings flew successfully ..	51
Total of data ..	100

In July of the same year, in the colony near the village Nikolaevka, 66 nests were inspected. 2 of them (3.1%) were unfinished, 3 (4.5%) were deserted before the egg-laying, 6 (9.1%) were deserted with clutches, 3 (4.5%) contained dead nestlings, and 52 (78.8%) live nestlings. So, as a result of unequal sex-ratio[1], of death of either one or both parents, of the destruction of nests by predators, or for some other reason, only 50-80% of nests are usually saved.

There are contradictory data as regards the number of broods in a year. Some workers consider that Spanish Sparrows nest only once in a season (Kashkarov *et al.*, 1926; Achmetov, 1953; Stegman, 1956a, b), while others think that there are two broods in a season (Brehm, 1911; Sudilovskaya, 1954; Umrichina, 1955).

The study of the gonads of these birds at the different stages of the reproductive cycle showed that the gonads of the males and females during the incubation and feeding of nestlings decreased only very slightly (Table V). This confirms their ability to resume the laying at any stage of the reproductive cycle. As stated above, some of the sparrows have normally two broods in a year. The birds that started their nesting early in the season—at the beginning or middle of May—had two full complements. The late comers, who occupied the colonies at the end of May or in June, raised only one brood.

TABLE V

CHANGE OF GONAD-SIZE IN THE SPANISH SPARROW AT DIFFERENT STAGES OF THE REPRODUCTIVE CYCLE

Sex	Measured gonads	Years	Stages of reproduction		
			Egg-laying	Incubation	Feeding of nestlings
♂♂	Testes (average length in mm.)	1959	9.1 (8)[2]	9.0 (21)	9.3 (11)
		1960	—	9.1 (25)	8.7 (25)
♀♀	Ovaries (average length, width, diameter of the largest follicle in mm.)	1959	12.3 × 8.4 d = 7.6 (9)	8.2 × 4.9 d = 1.9 (19)	7.8 × 4.8 d = 1.6 (10)
		1960	—	8.7 × 5.4 d = 2.0 (21)	6.9 × 4.1 d = 1.5 (44)

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[1] Unfinished nests are the product of the surplus males. The birds apparently failed to attract females, so deserted the nests and probably left the colony.

[2] Number of birds studied in brackets.

It is quite possible that the number of clutches of the Spanish Sparrow depends on the presence of favourable conditions for breeding, and potentially all adult sparrows may apparently hatch their broods several times in a year.

The fecundity of the Spanish Sparrow in different years is variable, as may be seen in Table VI.

TABLE VI

FECUNDITY OF THE SPANISH SPARROW IN DIFFERENT YEARS

	1959	1960	1961
Clutch-size ..	4.37	4.51	4.48
Nests with unfertilized eggs in % ..	14.8	11.3	26.2
Number of unfertilized eggs in % ..	4.3	2.4	7.4
Nests with dead embryos in % ..	2.5	7.2	5.4
Number of dead embryos in % ..	0.8	1.7	1.3
Number of hatched nestlings in each nest (average) ..	4.0	4.4	3.8
Number of nestlings that flew from each nest (average) ..	2.34	2.81	2.54
Number of females that nested twice in a year in % ..	45.4	4.6	21.0

Food. The Spanish Sparrow is a granivorous bird with strongly marked morphological devices for eating plant seeds.

During the spring migration the birds have the possibility of gathering food in various places. But they prefer areas under wheat cultivation, fields of spring crops, unploughed stubble fields, old threshing-floors, outskirts of villages, and so on. The seeds of cultivated crops are the staple food of sparrows. But when for some reason it is difficult to procure this, it becomes only a small part of the bird's diet. In such cases the Spanish Sparrow principally eats the seeds of the most easily available wild plants, visiting fallow land, weed-patches, etc. in the quest.

After settling in the nesting colonies the birds prefer to glean grains of the last year's crop, if they can find them. Otherwise their food is made up largely of insects and the seeds of wild plants. If the sparrows are late in settling in their nest colonies (i.e. end of May or beginning of June), and find insufficient grain left over from last year's harvest for gleaning, they readily attack ripening wheat crops while the grain is on the ear (in 'milk'). At this stage the birds cause heavy damage and loss of yield.

If the crops are not ready at the time the nestlings have to be fed, the sparrows feed themselves as well as their young almost exclusively on insects. If the feeding of the nestlings takes place later, then the staple food of the nestlings and adult birds consists of ripening wheat at the 'milk' and 'waxen' stages. After the fledglings become independent the birds begin their wide migrations. This is the time the grain crops are ripening and the harvesting begins.

As pointed out earlier (Kashkarov *et al.*, 1926; Umrichina, 1955) the sparrows do not usually touch the fully ripened ears. However, they readily eat the grain which is spilt, and according to our observations this comprises the principal food of the sparrows (98-100%) at this period.

From April to August the stomachs of 432 birds were examined. Seeds of cultivated cereals were found in 75% of the stomachs, seeds of wild plants in 13.6%, insects in 20.3%, and green grass in 7.0%. Thus the seeds of cultivated crops have a paramount importance in the diet of these sparrows. Insects and the seeds of wild plants play a subsidiary role, but may become the principal food items at certain periods and in particular conditions, when there is a lack of cultivated grain.

The nestlings of the Spanish Sparrow are fed principally on insects, as may be seen from Table VII. However, in some cases cultivated grain in 'milk' and 'waxen' stages of ripening may form a considerable portion of the nestlings' diet.

TABLE VII

FOOD OF SPANISH SPARROW NESTLINGS
(according to the data from 679 stomachs)

Food items	Occurrence in %
Seeds of cereals ..	34.9
Seeds of wild plants ..	0.3
Insects ..	89.5
Green leaves ..	0.3

The nestlings' food of many species of birds changes in accordance with their age. A similar state of affairs was also noted in the Spanish

Sparrows (Stegman, 1956b), which were found feeding their nestlings on insects, although the adults themselves fed on grain. The parents were feeding the older nestlings with insects as well as grain, and in the last days before flight chiefly with grain.

On 30 June 1960, in one colony near the village Chokpar we examined the stomach contents of 87 nestlings. The results are given in Table VIII.

TABLE VIII

FOOD OF SPANISH SPARROW NESTLINGS AT DIFFERENT AGES
(Occurrence in % of total number examined)

Age	1-6 days	7-11 days
Food items:		
Seeds of cereals ..	78.9	82.3
Insects ..	94.2	88.2
Total No. examined ..	19	68

It is possible that the change in the composition of the nestlings' diet may be explained not only by the need of the chicks for particular foods at different ages, but also by the availability at different periods of the most suitable food items. This is confirmed by the data on the feeding of nestlings and fledglings of the Spanish Sparrow near the village Chokpar in summer 1961 (Table IX).

TABLE IX

FOOD OF SPANISH SPARROW YOUNG AT DIFFERENT AGES
(Occurrence in % of total number examined)

Age	Nestlings		Fledglings		Total
Date	June 3	June 12-21	June 12	June 29	—
Food items :					
Insects ..	100.0	98.7	93.7	73.1	87.2
Seeds of cereals ..	3.7	9.8	12.5	67.6	34.0
Seeds of wild plants ..	—	—	3.1	—	0.2
No. examined ..	54	183	32	201	470

Thus when suitable cereals are available the parent sparrows use them for supplementing the nestlings' diet of insects, though they themselves may feed on grain almost exclusively. G. Umrichina (1955) reported that in the valley of the River Chu Spanish Sparrows fed their nestlings of the first and the second broods exclusively on the grain of the cereal crops. The development of extensive farming of cereal crops has provided the sparrows with an abundant and regular food supply. Since the various grains ripen at different times, the supply is maintained over a considerable period. But, as pointed out by A. S. Malchevski (1959), the nestlings of the sparrow also possess many characteristic morphological adaptations for an insectivorous diet. These are of survival value, since in nature it would be hard to find large enough concentrations of seeds of wild plants (such as human agriculture now provides) for sustaining such enormous breeding populations. This accounts for the fact that under natural conditions (where uninfluenced by agriculture) the Spanish Sparrow feeds its young during the greater part of their nest life exclusively, or at least principally, on insects.

TABLE X

AVERAGE WEIGHTS OF ADULT SPANISH SPARROWS (in grammes)

	April	May	June	July	August
Males ..	29.3 (8)	29.1 (129)	28.7 (118)	27.7 (27)	28.5 (4)
Females..	——	29.8 (106)	28.4 (143)	26.7 (36)	27.8 (3)

(Number of birds weighed in brackets)

Range of 286 males 24.5—37.5 ; average 28.89 gm.
288 females 23.7—37.8 ; average 28.82 gm.
(Weights include gonads and crops)

ACKNOWLEDGEMENTS

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A Note on the Eastern Spanish Sparrow, *Passer hispaniolensis transcaspicus* Tschusi, in India

BY

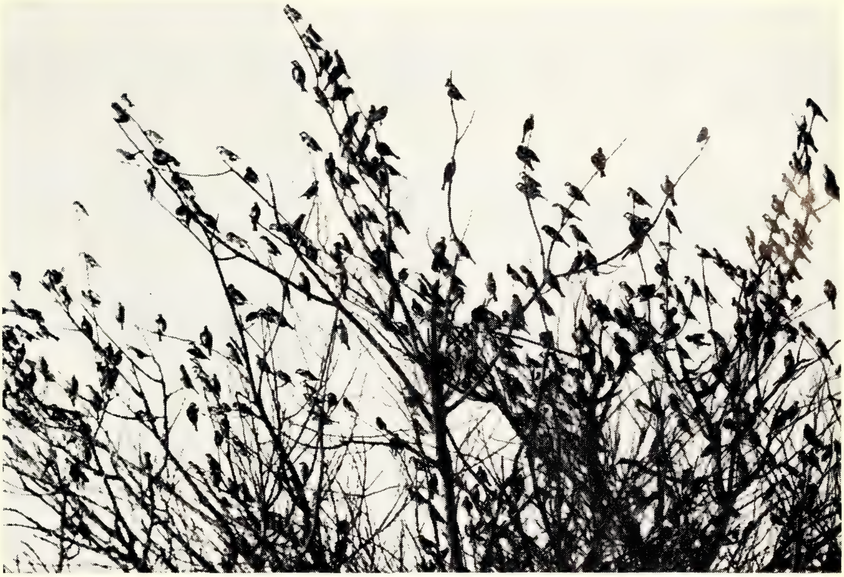
SÁLIM ALI

(*With a plate*)

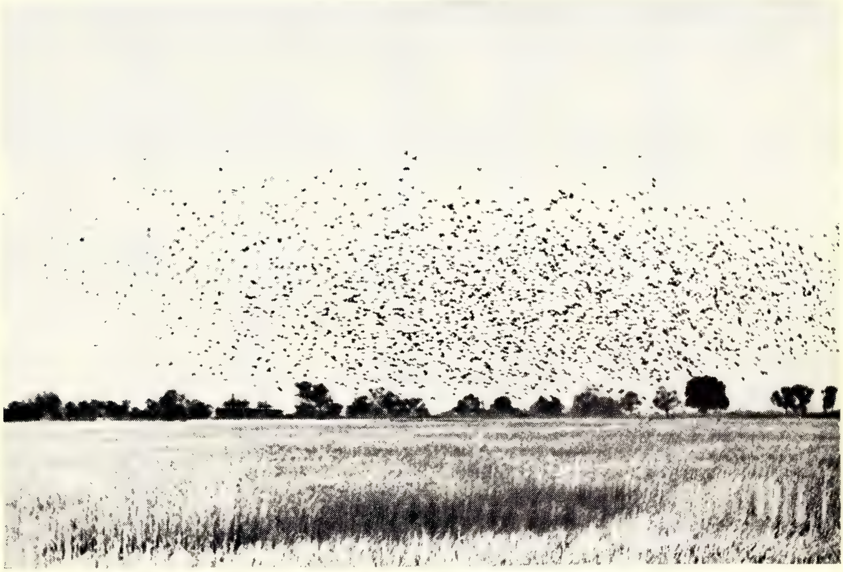
Little is recorded about the migratory Eastern Spanish Sparrow in India apart from its winter distribution in the country. This is summarized by Ripley, 1961 (SYNOPSIS: 594) as follows: 'A winter visitor to West Pakistan and India, straggling to northern Baluchistan, Chaman, Gilgit, Chitral, NW.F.P., Sind, Punjab, northern Rajasthan, U.P. east to Mirzapur, in the plains and low hills; sometimes in flocks in sarpat grass jungle, reed beds, edges of cultivation and scrub tropical thorn forest.' Whistler's excellent distribution maps [with his MS. notes now in the British Museum (Nat. Hist.)] show the southernmost Indian record as from *c*. 25° N., and easternmost as from *c*. 84° E. Thus, a few notes about its ecology and behaviour in its winter quarters would seem to be interesting.

Perhaps the best published account we have is that of Major Magrath from NW. India quoted by Lieut. C. H. T. Whitehead (1909, *Ibis*, January: 232-3) as follows: 'Mixed up with flocks of the last species (*Passer domesticus*), numbers of the present occur on the spring migration. At the height of the migration vast flocks of Sparrows in company with flocks of *Pastor roseus* pour into the station (Kohat) to roost. The combined noise of these birds before they have settled down to sleep is indescribable, and the smell of them becomes quite appreciable and rather offensive. Gardens, hedges, and trees are disgustingly soiled by the rain of their excreta. Shooting the birds is encouraged in Cantonments at this time, and every sepoy who can procure a gun slaughters to his heart's content. But notwithstanding these drastic measures little mitigation of the nuisance is effected.'

According to Whitehead spring passage in the NW. Frontier Province (now in W. Pakistan) begins in the second week of March and continues till mid-May when large numbers pass through the



Migratory sparrows in treetop before flying into roosting bushes. Bharatpur



Sparrow flock on its way to roost. Bharatpur

(*Photos : Sálim Ali*)

Kurram Valley. Return passage in autumn commences in early August and continues till October.

In Bahawalpur, W. Pakistan, in February/March I found small and large flocks of up to 100 birds or more, frequently in association with *Passer domesticus parkini,* about canal cultivation in desert and semi-desert biotope. In a specimen collected on 9 March the testes had enlarged to 4×3 mm. (1940, *J. Bombay nat. Hist. Soc.* **42** : 726).

The above information can now be supplemented with my experience of the Spanish Sparrow in Bharatpur (Rajasthan) between 15 March and 15 April 1962 during the BNHS/WHO bird migration study field camp. On 19 March an enormous roost was discovered about 7 miles (*c.* 11 km.) out on the road to Kumher and Deeg. It was a low-lying area of maybe a hundred acres or more of semi-desert thorn jungle—the hard-baked ground pock-marked with old hoof prints and cattle wallows, obvious signs of flooding during the monsoon. It was dotted about with bushes and shrubs—singly or in clumps—of *Zizyphus jujuba* and *Z. oenoplia, Capparis aphylla* and *C. horrida, Prosopis spicigera, Salvadora persica* and *S. oleoides,* and other xerophytic species. The dense assemblage of birds that concentrated to roost in this patch of thorn jungle at sunset may well be of the order of a million or more. They consisted chiefly of *Passer hispaniolensis transcaspicus* and *P. domesticus parkini* (presumably also *P. d. bactrianus* if one recognizes that race), and Redheaded Buntings (*Emberiza bruniceps*). The first two were about equally abundant, and among them were also mixed a few resident House Sparrows (*P. d. indicus*). The buntings varied significantly in numbers from day to day, apparently as they moved northward on emigration and were replaced by fresh waves from the Peninsula.

The vast mixed swarms of sparrows spent the day in the surrounding expanse of ripening wheat fields, where their ravages must be very serious indeed. The birds moved about in 'clouds' and settled from time to time amongst the crops to commit their depredations. When driven off by the slings and shouts of the watchmen, the cloud merely lifted from one field to settle in a neighbouring one. The disturbance served at best only to keep the birds moving and thus to distribute the damage over a wider area. It is only when one has witnessed the helplessness of the farmers and the magnitude of the swarms that one can appreciate, up to a point, the mass extermination of sparrows undertaken in China and elsewhere. In a recent campaign against these pests by the Institute of Plant Protection in Alma-Ata (Kirghizia, USSR) no less than 1.8 million sparrows were destroyed by poisoned grain. It is from this holocaust that 3 of the birds ringed by us in Bharatpur a few months previously were recovered. Two of these were Spanish Sparrows; the third, identified as *P. d. parkini* when ringed has been reported as '*P. d. bactrianus*' on recovery. (For details see *infra*, p. 461.)

It is curious that such a gigantic concentration of Spanish Sparrows should have gone unrecorded in India before, though it is doubtless a regular seasonal occurrence and possibly not confined to this area alone. At the Bharatpur roost the flocks of sparrows began to arrive a few minutes before sunset in a succession of dense swarms. The birds usually alighted on the leafless branches of bare treetops in the neighbourhood, flying about restlessly to perch again on small trees and shrubs standing amidst the wheat fields. From time to time they descended into the crops presently to rise again and settle elsewhere. The masses in the bare treetops silhouetted against the evening sky looked in the distance like a dense crop of foliage. On 3 April, fourteen days after its discovery, the sparrow roost was noted as being more fantastically populous than ever, and it was obvious that the birds were being augmented by fresh arrivals, maybe preparatory to emigration. Unfortunately it was not possible to ascertain when the birds actually left.

From a little before till a little past sunset—during 20 minutes or so—the sky was filled with a continuous stream of birds all hurrying from long distances over the extensive wheat fields in the direction of the roosting jungle. The stream was boosted from time to time by denser waves of birds, the noise of whose wings was like surf breaking on a sandy beach—reminiscent also of a distant rain storm advancing over broad-leaved forest. The sparrow flocks were interlarded with flocks of Rosy Pastors, which had increased progressively in the last few days, also hurrying towards the roost. The roosting bushes can be easily recognized even in daytime, when unoccupied, by the masses of the birds' droppings on the branches and leaves and the ground beneath, and the acrid stench the place exudes.

In March and April the Spanish Sparrows in Bharatpur were all in freshly moulted plumage and excessively fat. Some 1293 birds were netted and ringed at this roost between 22 March and 3 April—857 males, 436 females. Measurements of 100 adult males and 100 adult females picked at random from the above, are as follows:

Males: Wing 73-87 mm. (av. 79.98); Weight: 20-28 gm. (av. 24.9).

Females: Wing 73-82 mm. (av. 77.07); Weight: 18-28 gm. (av. 23.49).

It is interesting to compare the above figures with Table X in Dr. Gavrilov's paper (p. 316 above) and with similar data obtained by Paludan on 15 October 1949 in Afghanistan of birds in fresh post-nuptial plumage, presumably on autumn passage. Paludan gives:

1 *male:* Wing 81 mm.; Weight 33 gm. 4 *females:* Wing 77, 79, 81, 81 mm.; Weight 29, 29, 30, 30 gm. Therefore, in autumn both sexes would seem to be considerably heavier than before emigration in spring from their Indian winter quarters!

The adult male Spanish Sparrow has a heavy black bill with a hawfinch-like profile, broad and flat-convex dorsally near the forehead. It has a prominent white loreal streak in front of the eye with a shorter continuation behind it, broken above the eye by a black spot. The tarsus was noted as being appreciably stouter than in either *P. d. parkini* or *P. d. indicus.*

Up till 24 September no Spanish Sparrows were observed in Bharatpur on the autumn immigration although our catches of sparrows at this time included a few *P. d. parkini* (and/or *bactrianus*?) along with the resident race of the House Sparrow. The dates of arrival or departure have not been recorded.

Description of a new Geckonid Lizard from Maharashtra, India

BY

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AND

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(*With two plates*)

Hemidactylus albofasciatus sp. nov.

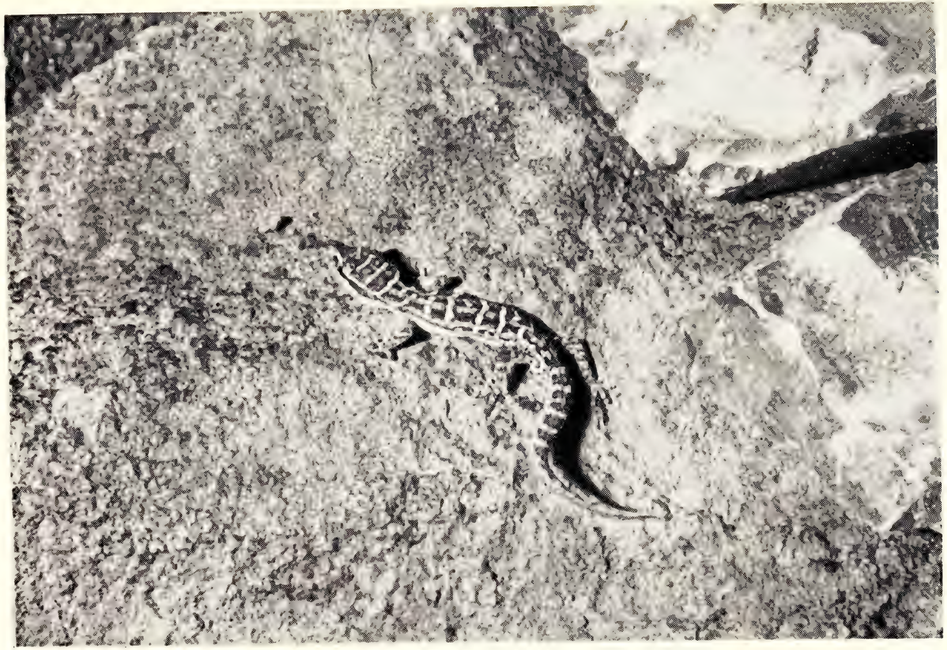
Material Examined. Holotype (No. BNHS. 148), adult ♂, in the collections of the Bombay Natural History Society, collected by the junior author in January 1962 at Dorle village, Rajapur Taluka, Ratnagiri District, Maharashtra.

Paratypes, 11 ♀♀, 14 ♂♂, and four hatchlings collected at

- Dorle village, Rajapur Taluka, Ratnagiri District, Maharashtra, in the months of January 1962, and January 1963;
- Dabhil village, Taluka and District Ratnagiri, Maharashtra, in January 1963;
- Gavkhadi village, Rajapur Taluka, Ratnagiri District, in January 1963.

These will be deposited in the collections of the British Museum (Natural History), Bombay Natural History Society, and the Zoological Survey of India, Calcutta.

Diagnosis. Small, slender gecko; scales of the dorsum small, keeled and granular, intermixed with irregularly arranged, enlarged, keeled tubercles. Subdigital lamellae in straight, transverse series; undivided except for the penultimate and two or three more proximal plates which are notched; eight or nine, exceptionally ten (1), lamellar plates under the fourth toe, five under the first toe. Only the distal two or three finger lamellae notched; otherwise the lamellae are entire. Lamellar plates under the fingers number 5, 6, 7, 7, 7, counting from the first to fifth respectively. Usually one pair of post-mentals,

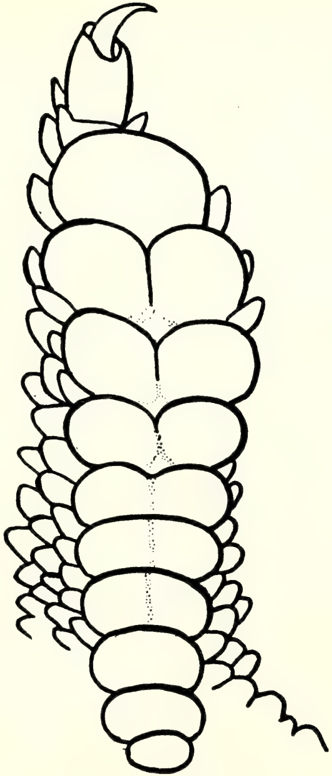


Hemidactylus albofasciatus sp. nov.

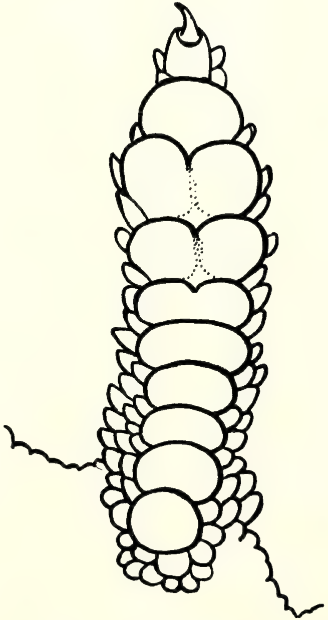
(*Photo : S. R. Sane*)

Area of collection at Dorle village, Ratnagiri District, Maharashtra

(*Photo : P. W. Soman*)



Hemidactylus reticulatus, undersurface of the 4th toe of one of the types



Hemidactylus albofasciatus sp. nov., undersurface of the 4th toe rarely two or three pairs, which may (17) or may not (9) form a suture on the median line. Other chin shields gradually merge in size with the gular scales. Males with seven (1), eight (9), nine (3), or ten (2) preanal pores arranged in a widely angular or almost straight series, uninterrupted mesially. Tail cylindrical, tapering fairly rapidly, with a median furrow; scales of the tail considerably larger than those on the dorsum, faintly keeled or striated, imbricate, arranged in whorls, 28 scales round the third whorl at its posterior edge; a denticulation on each side formed from two to three longitudinal series of enlarged, keeled, pointed but rather flat scales; subcaudals subequal. A conspicuous white band from the nostril to above the ear; dorsum and tail cross-banded with light streaks.

Description of Holotype. Head moderate, snout obtusely pointed, distance from tip of snout to anterior border of eye only very slightly greater than distance from posterior border of eye to anterior border of ear. Diameter of ear $\frac{1}{8}$th diameter of eye. Eight upper labials, seven lower labials. Mental triangular, its length equal to the width of the first lower labial; one pair of post-mentals, not forming a suture. Rostral $1\frac{1}{2}$ to $1\frac{3}{4}$ times as broad as deep. Nostril between rostral, first labial and three scales, the uppermost separated from its fellow by one internasal. Head covered with small granules, those on the snout keeled and considerably larger than the granular, conical, parietal scales. Back with small, keeled granules, intermixed with larger trihedral tubercles, which are twice as large as the granules. About 80 midbody scales. Tubercles arranged irregularly, separated by one to three granular scales. Belly with smooth, rounded, imbricate scales. Digits free, with little dilation; distal joints rather short; nine lamellae under the fourth toe, the seventh and eighth deeply notched, the remainder without any indentation. Five lamellae under the first toe, the penultimate indented. Adpressed hind limb reaches to the elbow of the adpressed fore limb. A vertebral groove continuing on to the tail where it is more pronounced. Tail round in section, tapering, verticillate, covered above with faintly keeled, pointed imbricate scales; in the middle of each whorl and to either side of the vertebral line are two longitudinal rows of larger, pointed, keeled scales; 28 scales round the tail at the posterior edge of the third whorl. Ventral surface of the tail with subequal, somewhat pointed, smooth, imbricate scales. A slightly curved series of eight preanal scales, not interrupted mesially. Ground colour dark brown; a whitish streak, two scales wide, runs from the nostril, through the eye to above the ear. Ten narrow, somewhat wavy, whitish bands run transversely from behind the eyes to the hind limbs; interspaces three times the width of a band. Tail similarly cross-banded at each alternate whorl. Ventral surfaces cream with fine brown speckling. A longitudinal, midventral dark line is present on the tail.

Measurements.	Snout to Vent	29.6 mm.
	Tail	26.5 mm.

Field Notes. The type locality of *H. albofasciatus* is on the open, rocky crests of the hills in the Ratnagiri and Rajapur talukas of Ratnagiri District between 15° 44′ to 17° 17′ N. and 73° 12′ to 72° 52′ E., SW. Maharashtra State. Although the crests bear a few patches of scrub, mainly *Carissa carandas* and *Holarrhena antidysenterica*, the surrounding country is jungle of a semi-evergreen nature.

The geckos are nocturnal and by day they remain concealed beneath stones. Many clutches of two eggs were found in January; the eggs measure from 7.5×6.0 mm. to 9.0×7.0 mm.

The livery of the juvenile at birth is dark brown on the dorsum with three darker, longitudinal lines, one on the vertebral region, the other two more lateral and running from the shoulder to the base of the tail. The tail is brick red with narrow, dark lines on the upper surface. The belly is whitish.

Affinities. Allied to *Hemidactylus reticulatus* Beddome, from which it differs mainly in dorsal pholidosis, in the nature of the subdigital lamellae, in tail scalation, and in pattern. In *H. reticulatus* the dorsal tubercles are more numerous and are separated from each other by one (rarely two) scales. A vertebral band, three scales wide, in which no tubercles are developed is present; the scales in this band are smaller than those separating the tubercles. Although Beddome (1870), Boulenger (1885), and Smith (1935) make no mention of there being undivided subdigital lamellae in *H. reticulatus*, in fact the basal five or six lamellae under the fourth toe are without any indentation, although a groove is usually present. The plate adjacent to the terminal scansor is always deeply indented and might almost be thought to be divided; but division is not complete, as is evident when the lamellae are sloughed. Likewise the one or two plates proximal to this one, although the indentation is less developed. Only the greater indentation of the plates and the grooving of the basal ones distinguish the digits of *reticulatus* from those of *albofasciatus*, although there appears also to be more dilation of the distal halves of the digits. The tail denticulation of *reticulatus* is formed from eight (4+4) longitudinal rows of enlarged, keeled, almost conical scales, as opposed to four (2+2) to six (3+3) rows of keeled, rather flat, pointed scales in the new species. A dorsal, median tail furrow is absent in *reticulatus*. There is also a greater disparity in the size of the dorsal tail scales and the spines in *reticulatus* and the number of scales round the posterior edge of the third whorl is 34-40. The pattern of *reticulatus* is basically, as the name implies, a network. Dark brown lines on a lighter brown background form an open mesh over the head and dorsum. Longitudinal lines from the eye to the ear, or as far as the insertion of the arm are usually pronounced. The dorsal tubercles are usually whitish.

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A Taxonomic Study of the Genus *Indigofera* Linnaeus in Rajasthan

BY

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INTRODUCTION

The genus *Indigofera* Linn. comprises a little more than 300 species distributed in the tropical zones. Africa claims the largest number of species. About 42 species are reported from India. In the existing floras and other similar publications, including some of the more recent ones, the genus is treated more or less unsatisfactorily with frequent uncertainties in specific conception, nomenclature, and description. An exhaustive taxonomic investigation of the genus as represented in India has, therefore, been highly desirable for a long time. The present work is an attempt to give a morphological and taxonomical account of the representatives of the genus in Rajasthan. The work was started in 1956 by one of us (NCN). By the time our work progressed considerably, Ali (1958) published his revision of the genus *Indigofera* from Pakistan and NW. Himalayas. This work was very helpful in the completion of the present account. It must be mentioned that the species of *Indigofera* found in Rajasthan have not earlier been the subject of a comprehensive taxonomic investigation. Although the representative species were few, the work was more time-consuming than was thought likely in the beginning, particularly because we have attempted to study the material in the field itself and to examine the herbarium sheets from almost all the districts of Rajasthan. Therefore our place of work was now the museum, now the laboratory, and now the field. A very large sample of each species has been studied closely. This would have been impossible without the materials obtained from various quarters and facilities given to us by various museums for studying the herbarium sheets. We therefore owe a great debt of gratitude to the numerous persons we have troubled. Of the various persons who helped us we should like to mention in particular Rev. Fr. H. Santapau, St. Xavier's College, Bombay (now Chief Botanist, Botanical Survey of India), who gave to one of us facilities to work in Blatter Herbarium, and who went through the manu-

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script and suggested several improvements ; the Regional Botanist, Botanical Survey of India, Western Circle, Poona, for permission to study herbarium sheets ; Dr. K. M. Gupta and Mr. V. S. Sharma of Government College, Ajmer, Drs. H. S. Narayana and B. Tyagi of the University of Rajasthan, Jodhpur, Messrs. Ganga Singh Natawath of Maharajah's College, Jaipur, and L. N. Vyas of Government College, Alwar, for lending their herbarium sheets. Most part of the investigation has been carried out in the Department of Botany, Birla College, Pilani. To the Head of the Department, Dr. B. N. Mulay, we proffer our warmest thanks not only for the facilities given to us but also for encouragement given and interest taken in the work.

KEY TO THE SPECIES OF *INDIGOFERA* OF RAJASTHAN

Pods 1- to 2-seeded:
Leaves simple ovate cordate .. .. .. 1. *cordifolia*
Leaves simple not cordate :
Leaves linear, internode long, inflorescence up to 20-flowered raceme .. .. .. 2a. *linifolia*
Leaves obovate-obtuse, internode short, inflorescence 1- to 4-flowered raceme .. 2b. *linifolia* var. *campbellii*
Leaves compound :
Leaflets three .. .. .. 3. *glandulosa*
Leaflets more than three, up to 11 .. .. 4. *linnaei*

Pods more than 2-seeded :
Pods flat curved slightly .. .. .. 5. *hochstetteri*
Pods angular :
Leaves simple .. .. 6. *dalzellii*
Leaves compound :
Leaflets more than three .. .. .. 7. *astragalina*
Leaflets three, pods slightly curved at the base .. .. 8a. *trita* var. *trita*
Leaflets three, pods drooping and not curved at the base .. .. 8b. *trita* var. *subulata*
Pods torulose :
Inflorescence axillary short peduncled globose spike .. .. 9. *sessiliflora*
Inflorescence raceme, shorter than the leaves :
Leaves pilose on both sides .. .. 10a. *caerulea* var. *occidentalis*
Leaves glabrous adaxially .. .. 10b. *caerulea* var. *subulata*
Inflorescence exceeding the leaves :
Leaves compound, rarely unifoliate, leaflets alternate .. .. .. 11. *oblongifolia*

Leaves always compound, leaflets opposite :
  Seeds discoid with irregular depressions .. .. 12. *argentea*
  Seeds concave with a raised ridge in the centre .. .. 13. *angulosa*
Pods almost cylindric :
  Pods with depressed white hairs .. .. .. 14. *wightii*
  Pods glabrous :
    Leaflets more than seven .. .. .. 15. *tinctoria*
    Leaflets less than seven .. .. .. 16. *glabra*

ENUMERATION OF THE SPECIES OF *INDIGOFERA* OF RAJASTHAN

1. **Indigofera cordifolia** Heyne ex Roth, Nov. Pl. Sp. 357, 1821. *Description :* Cooke, Fl. Pres. Bomb. (Reprint) 1 : 331, 1958. This description should be supplemented as follows : pods frequently 1-seeded ; seeds sometimes white, ovate, truncate at one end, pitted ; pericarp with black spots inside.

Specimens examined. Jodhpur: *Blatter* 7179, 7183 ; *S. K. Tandon* 231; *G. S. Puri* 4037. Ajay Sagar (Ajmer) : *V. S. Sharma* 81. Khetri : *Kanodia* 1146, 1149 ; *Nair & party* 1150. Kotah : *Bhartya* 1161. Pilani : *R. K. Joshi,* 1144 ; *Natawath* 1147 ; *Kusum Kanta* 1148 ; *Padmanabhan* 1153 ; *Tripathi* 1156 ; *Dhami* 1157 ; *Sukumaran* 1160 ; *Prabha Bhatnagar* 1162.

Distribution. India, W. Pakistan, Baluchistan, Afghanistan, Africa, Sudan, Ethiopia, Eritrea, Timor, Australia.

Flowering period. August-December.

Ecological notes. Common in sandy waste ; good sand binder ; sometimes pioneer on fresh sand dunes ; rarely in crevices of rocks. Pods eaten by pigeons ; ants seem to have a special liking for them.

2a. **Indigofera linifolia** (L. f.) Retz. Obs. 4 : 29, 1786 & 6 : t. 2, 1791 ; Wight, Icon. t. 313, 1840. *Hedysarum linifolium* Linn. f. Suppl. 331, 1781. *Sphaeridiophorum linifolium* (Linn. f.) Desv. in J. Bot. 1 : 125, t. 6, f. 35, 1813. *S. abyssinicum* Jaub. & Spach. Illust. Pl. Or. t. 494. *Indigofera polygonoides* Wendl. Bot. Beobacht. 55, 1798.

Description : Cooke, Fl. Pres. Bomb. (Reprint) 1 : 330, 1958. This description should be supplemented as follows : flowers 6-22 in each raceme.

According to Duthie (1903) the plant is perennial and the flowers are sometimes white. The plant can be an annual or perennial in the same population. None of the specimens examined had white flowers.

Specimens examined. Jodhpur : *Blatter* 7039, 7040 ; *S. K. Tandon* 271. Ajmer : *V. S. Sharma* 580. Kotah : *T. T. Koshy* 16. Khetri : *Kanodia* 1209. Pilani : *Omkumari* 1197 ; *Khamboj* 1198 ; *Bhatnagar*

1199 ; *Padmanabhan* 1200 ; *Natawath* 1201 ; *Bharadwaj* 1202 ; *Khushlani* 1204 ; *Bahl* 1205 ; *Tripathi* 1206 ; *Vasu Pillai* 1207 ; *Mukherji* 1208.

Distribution. Throughout India, W. Pakistan, Afghanistan, Eritrea, Ethiopia, Sudan, Ceylon, E. Pakistan, Burma, Indochina, Siam, Indonesia, New Guinea, Australia (Queensland, New South Wales), China, Yunnan, Szechuan, Formosa.

Flowering period. July-December ; occasionally even up to March.

Ecological notes. Common in sandy areas as well as hillocks. Seeds eaten by pigeons.

2b. **Indigofera linifolia** var. **campbellii** Wight ex Baker in Hook. f. Fl. Brit. India 2 : 93, 1879.

Differs from *I. linifolia* in having shorter internodes, shorter leaves up to 1.8 cm. long, obovate to obtuse, and 1- to 4-flowered short axillary racemes.

Specimens examined. Kotah : *Bhartya* 1192. Harigarh : *Chuda* 1193.

Distribution. Plains of India.

Flowering period. July-December.

Ecological notes. Rare. On hills in crevices of rocks.

3. **Indigofera glandulosa** Willd. Sp. Pl. 3 : 1227, 1800.

Description : Cooke, Fl. Pres. Bomb. (Reprint) 1 : 332, 1958. This description is to be supplemented as follows : petiole as long as the leaflets ; flowers red, 7 to 11 in an inflorescence ; pods brownish ; seeds reddish.

Specimens examined. Pilani: *Varghese* 1186. Harigarh: *Chuda* 1187.

Distribution. Bihar, central India.

Flowering period. August-October.

4. **Indigofera linnaei** Ali in Botan. Notis. 111 : 549-550, 1958. *Hedysarum prostratum* Linn. Mant. 1 : 102, 1767. *H. prostratum* Burm. f. Fl. Ind. 168, t. 55, f. 1, 1768. *Indigofera prostrata* (Burm. f.) Domin in Bibl. Bot. Stuttgart : 187, 1926, non Willd. (1803). *I. enneaphylla* Linn. Mant. 2 : 272, 1771. Append. 571, 1771.

This is *Indigofera enneaphylla* Linn. of Indian floras. As shown by Ali (1958) the names *Hedysarum prostratum* Linn., *H. prostratum* Burm. f., and *Indigofera prostrata* (Burm. f.) Domin are invalid. Cooke (Reprint, 1958) regarded *I. semitrijuga* as a synonym of *I. enneaphylla.* Ali (1958) pointed out that the photograph of the holotype of *I. semitrijuga* reveals that it is a different species. Thus Ali (1958) proposed a new name *I. linnaei* for the taxon.

Description : Ali, Botan. Notis. 111 : 449-550, 1958. Ali reports 3-seeded pods, but none of the material we examined had 3-seeded pods.

Specimens examined. Khetri : *Kanodia* 1167, 1171. Harigarh :

Chuda 1185 ; Ajmer : *V. S. Sharma* 326. Jodhpur : *Shanti Sarup* 59. Kotah : *T. T. Koshy* 7. Sawaimadhopur : *Dhami* 1172. Pilani : *Tripathi* 1173 ; *R. K. Joshi* 1174 ; *Padmanabhan* 1175 ; *Chhajlani* 1178 ; *Natawath* 1179 ; *Bishnoi* 1180 ; *T. T. Koshy* 2.

Distribution. Ali (1958) wrongly states that this species is not found in Rajasthan. Throughout India, W. Pakistan, Ceylon, Burma, Siam, Indochina, Indonesia, Java, New Guinea, Australia (N. S. Wales).

Flowering season. Cooke reports October to be the flowering season of the species. In Rajasthan it begins flowering from August and extends up to January.

5. **Indigofera hochstetteri** Baker in Oliver, Fl. Trop. Afr. 2 : 101, 1871 ; Jaub. & Spach. Illustr. Pl. Or. 5 : t. 480, 1856. *Indigofera anabaptista* Steud. ex Baker in Hook. f. Fl. Brit. Ind. 2 : 102, 1876. *I. arenaria* A. Rich. Tent. Fl. Abyss. 1 : 183, 1847 (non E. May, 1835-1837). *I. ornithopodoides* Hochst. ex Jaub. & Spach. Illust. Pl. Or. t. 480, 1856 (non Cham. & Schlecht. 1830). *I. jaubertiana* Schweinf. in Bull. Herb. Boissier, App. 2 : 1876.

Description : Cooke, Fl. Bomb. Pres. (Reprint) 1 : 334, 1958. This description should be supplemented as follows : inflorescence sometimes longer than the leaves ; pods 6- to 8-seeded.

According to Hooker and Duthie the number of leaflets varies from 3 to 7. In the material examined the maximum number was 5.

Specimens examined. Jodhpur. *Blatter* 7055 ; *S. K. Tandon*, 14. Khetri : *Nair* 522. Ajmer : *V. S. Sharma* 1083. Madarpura : *V. S. Sharma* 609. Kotah : *Bhartya* 1131. Pilani : *Dhami* 1132 ; *Joshi* 1133 ; *Deshpande* 1134 ; *Mahajan* 1140 ; *Surjit* 1135 ; *Chuda* 1137.

Distribution. W. Pakistan, Afghanistan, Arabia, Somalia, Ethiopia, Eritrea, Sudan, Nigeria, Kenya, Uganda, Tanganyika, French Sudan, Belgian Congo, India.

Flowering period. August-October.

6. **Indigofera dalzellii** T. Cooke, Fl. Pres. Bomb. 1 : 311, 1902. *I. triquetra* Dalz. in Hook. Kew Jour. 2 : 36, 1850.

Description : Cooke, Fl. Pres. Bomb. (Reprint) 1 : 331, 1958.

Specimens examined. Only one sheet collected by Natawath from Jaipur in 1953. The sheet is not in good condition and the label incompletely filled.

Distribution. Western India.

7. **Indigofera astragalina** DC. Prodr. 2 : 228, 1825.

A herb 60-120 cm. high, densely covered with soft greyish or slightly brownish hairs. Leaves up to 12.9 cm. long, short-petioled ; stipules setaceous ; leaflets 9 to 11, very rarely 7, opposite, 3.5 to 5 cm. long, obovate to oblanceolate, membranous, hairy on both surfaces, greyish green above, glacous beneath. Racemes axillary, 5 to 15 cm. long ; peduncles less than 25 mm. long. Flowers many, crowded. Calyx 4 to 6 mm., teeth of different sizes, setaceous. Corolla scarcely exserted, reddish to pink, hairy ; keel petals united. Pod pointing downwards, straight, 4-angled, densely pubescent, 1.2 to 2 cm. long, 0.3 mm. wide, 3- to 6-seeded. Seeds cylindric, inner surface of pericarp and septa separating the seeds spotted brown.

This species has been only very recently reported from India. Very often the taxon is confused with *I. hirsuta* Linn. Hooker & Bentham (1849) treated *I. astragalina* DC. as a synonym of *I. hirsuta* Linn. The characters which have been used to differentiate the two species include length of peduncle, breadth of pod, number of seeds, colour of hairs on the pod, number of leaflets, and length of pod. According to Ali (1958) none of these characters can be applied with complete success to distinguish *astragalina* from *hirsuta.* He therefore treated *I. hirsuta* (including *I. astragalina* DC.) as a single polymorphic species. Gillett (1960), on the other hand, took exception to the above treatment. According to him the two species can be differentiated on the following characters :

Longer peduncles nearly always over 25 mm. long ; pod usually 6- to 9-seeded, 0.2 mm. wide, some or all of the hairs on the dorsal surface usually brown ; largest number of leaflets on any one leaf 7, or less often 9.. .. .. ..*hirsuta*

Longer peduncles under 25 mm. long ; pod usually 4- to 6-seeded, 0.3 mm. wide, the hairs on its dorsal surface usually white ; largest number of leaflets on any one leaf usually 9 or 11, occasionally 7.. .. ..*astragalina*

In our material the hair is sometimes brownish.

Specimens examined. Khetri : *Nair* 400, 975 ; *Nair and party* 1188. Punch Kund (Ajmer) : *V. S. Sharma* 408. Ajay Sagar (Ajmer) : *V. S. Sharma* 80.

Distribution. India and tropical Africa.

Flowering period. August-November.

8. **Indigofera trita** Linn. f. Suppl. Pl. 335, 1781.

I. trita L. f. and *I. subulata* Vahl ex Poir. are closely related. The distinction between the two was based chiefly on the number of leaflets (Baker, 1871, 1876). *I. subulata* is regarded as a five-foliolate plant. Meikle (1951) has pointed out that this is erroneous as the species is trifoliolate. He placed all five-foliolate plants, previously included under *I. subulata,* in *I. subulata* var. *scabra* (Roth) Meikle.

Under *I. subulata* Vahl ex Poir. Gillett (1958) recognised the following taxa :

- i. var. *nubica* Gillett
- ii. var. *microphylla* Chiov.
- iii. var. *maffei* (Chiov.) Gillett.

After studying the various taxa put under *I. trita* L. f. and *I. subulata* Vahl ex Poir., Ali (1958) transferred all plants previously attributed to *I. subulata* to *I. trita*. He recognises the following taxa under *I. trita* :

- (*a*) Subspecies *trita*
  - i. var. *trita*
  - ii. var. *maffei* (Chiov.) Ali
- (*b*) subspecies *subulata*
  - i. var. *subulata*
  - ii. var. *scabra* (Roth) Ali.

Of the four taxa recognised by Ali (1958) only subspecies *trita* var. *trita* and subspecies *subulata* var. *subulata* occur in Rajasthan.

8a. Subspecies **trita** var. **trita**. *I. cinerea* Willd. Sp. Pl. 1225, 1803. *I. rigidula* Willd. Enum. 780, 1809. *I. timoriensis* DC. Prodr. 2 : 223, 1825. *I. leschenaultii* DC. Prodr. 2 : 223, 1825. *I. canescens* Lam. Encycl. Meth. 3 : 251, 1789. *I. hedysaroides* Lam. Encycl. Meth. 3 : 250, 1789.

Description: Parker, For. Fl. Punj. 127, 1956. This description should be supplemented as follows : seeds smooth, slightly concave with a raised ridge in the centre.

Specimens examined. Kotah : *S. K. Jain* 4118, 4119 ; *T. T. Koshy* 4, 10.

Flowering period. September-November.

Ecological notes. In moist places, browsed upon by cattle.

8b. Subspecies **subulata** (Vahl ex Poir.) Ali in Botan. Notis. 111 : 558, 1958 var. **subulata** *I. subulata* Vahl ex Poir. in Lam. Encycl. Meth. Supp. 3 : 150, 1813. *I. subulata* var. *microphylla* Chiov. in Atti Inst. Bot. Univ. Pavia, Ser. 4, 7 : 128, 1936. *I. subulata* var. *nubica* Gillett in Kew Bull., Add. Ser., 13, 1958.

Differs from the above taxon in the larger leaves, up to 6.2 cm., longer petioles, up to 1.8 cm., longer inflorescence axis, between 2.5 and 4.4 cm., larger number of flowers, drooping fruits not curved at the base, slightly longer pods, up to 2.8 cm., and pyramidal seeds.

Specimens examined. Alwar : *R. K. Bhartya* 346.

In Ali's Fig. 2, showing the distribution of the species the taxon does not extend into India.

Distribution. Rajasthan, Africa, Arabia.

Flowering period. July-December.

9. **Indigofera sessiliflora** DC. Prodr. 2 : 228, 1825. *I. tribuloides* Boiss. Fl. Or. 2 : 189, 1872. *I. trigonelloides* Jaub. & Spach. ex Baker in Hook. f. Fl. Brit. India 2 : 94, 1876.

In the existing Indian floras this species is referred to as *I. trigonelloides* Jaub. & Spach. According to Gillett (1958) and Ali (1958), the correct name of this taxon is *I. sessiliflora* DC. ; *I. trigonelloides* Jaub. & Spach. is confined to SW. Africa and Ethiopia and does not extend into India.

There is remarkable difference in the number of chromosomes between *I. sessiliflora* DC. collected from Africa and India. The chromosome number of the species from Africa is $2n=32$ (Darlington & Wylie, 1955) and that of India is $2n=16$ (Ramanathan, 1955).

Description : The description of *I. trigonelloides* Jaub. & Spach. as given by Cooke, Fl. Bomb. Pres. (Reprint) 1 : 332, 1958. This description should be supplemented as follows : pods about 22 in the axils of leaves, up to 9 mm. long, cylindric, beaked ; seeds 3 to 4, rarely 2 or 6, globose.

Specimens examined. Jodhpur : *Blatter* 7075. Pilani : *Kahate* 1215 ; *T. T. Koshy* 3, 8 ; *Nair* 1002.

Distribution. W. Pakistan, Punjab, Arabia, Eritrea, Sudan, French Sudan, Fr. Niger Colony, Senegal.

Flowering period. August-October. February-April in Pakistan (Ali, 1958).

10. **Indigofera caerulea** Roxb. Fl. Ind. 3 : 377, 1832.

This species is known by the name *I. articulata* Goüan in most of the Indian Floras [Prain, 1897 ; Cooke (Reprint), 1958 ; Gamble, 1957 ; Duthie, 1903]. Baker (1876, in Hook. Fl. Brit. India) regards it as a variety of *I. argentea* Linn. According to him *I. argentea* Linn. is a synonym of *I. articulata* Goüan. Ali (1958) pointed out that *I. argentea* is a *nomen ambiguum*. *I. articulata* Goüan and *I. caerulea* Roxb. are two distinct species (see Ali, 1958). Cooke (Reprint, 1958) and Blatter (1921) have preferred *I. houer* Forsk. in preference to *I. caerulea* Roxb. As pointed out by Ali, the name *I. houer* Forsk. should be regarded as *nomen ambiguum* and therefore must be rejected.

Gillett & Ali (1958) distinguish a variety in this species, *I. caerulea* var. *occidentalis* Gillett et Ali.

10a. **Indigofera caerulea** var. **caerulea**

Description : Description of *I. houer* given by Cooke, Fl. Bomb. Pres. (Reprint) 1 : 338-339, 1958. This should be supplemented as follows: leaflets glabrous adaxially ; seeds usually 3 to 4 per pod, rarely 2 or 5, separated by partitions.

Specimens examined. Beer Hills : *V. S. Sharma* 391. Ashagunj (Ajmer) : *V. S. Sharma* 825.

Distribution. W. Pakistan, Baluchistan, Arabia, Eritrea, Somaliland, Sudan, India.

Flowering period. Throughout the year.

Ecological notes. Prefers hilly areas.

10b. **Indigofera caerulea** var. **occidentalis** Gillett et Ali in Kew Bull., Add. Ser., 13 : 102, 1958, *I. articulata* auct. non Goüan. Cooke, Fl. Pres. Bomb. (Reprint) 1 : 336, 1958.

Differs from *I. caerulea* var. *caerulea* in having leaflets pilose on both sides and in the frequency of more than 4-seeded fruits.

Specimens examined. Khetri : *N. C. Nair* 423.

Distribution. W. Pakistan, Arabia, Mauritius, Ethiopia, Somaliland, Kenya, Sudan, French W. Africa, Rajasthan (India).

Flowering period. October.

Ecological notes. In fertile fields and river beds ; eaten by cattle. Rare.

11. **Indigofera oblongifolia** Forsk. Fl. Aegypt-Arab. 137, 1775 ; Delile, Fl. Egypt. 1 : t. 37, f. 22, 1812 ; Wight, Icon. t. 33, 1840-1843. *I. paucifolia* Delile, Fl. Egypt. 251, 1812. *I. argentea* Roxb. Fl. Ind. 3 : 374, 1832 (non Linn. 1771). *I. desmodioides* Baker in Kew Bull. : 331, 1894. *I. oblongifolia* var. *carposphigma* Schweinf. in Bull. Herb. Boissier 4, App. 2 : 240, 1896.

Description : The description of *I. paucifolia* Delile is as given by Cooke, Fl. Pres. Bomb. (Reprint) 1 : 334, 1958. This description should be supplemented as follows : leaves rarely unifoliate.

Specimens examined. Ajmer : *V. S. Sharma* 182. Jodhpur : *Blatter* 7070 ; *Bhandari*, 186.

Distribution. W. Pakistan, Baluchistan, Jordan, Yemen, Hejaz, Bahrein, Eritrea, Somaliland, Egypt, Sudan, Senegal, Angola, Fr. Niger Colony, Nigeria, Java, Ceylon, India.

Flowering period. September-November.

12. **Indigofera argentea** Burm. f. Fl. Ind. 17, 1768 (non Linn. 1771). *I. semitrijuga* auct. non Forskal. Baker in Hook. f. Fl. Brit. India 2 : 98, 1876. *I. semitrijuga* var. *tetrasperma* DC. Prodr. 2 : 230, 1825. *I. burmannii* Boiss. Fl. Or. 2 : 189, 1872.

Description : Cooke, Fl. Bomb. Pres. (Reprint) 1 : 338, 1958. This description should be supplemented as follows : pods slightly torulose ; generally 4 to 6, rarely up to 8-seeded ; seeds more or less discoid with irregular depressions.

Specimens examined. Jodhpur : *Blatter* 727, 7028 ; *S. K. Tandon* 412 F.

Distribution. Rajasthan, Punjab, W. Pakistan, Baluchistan, Arabia, Egypt, Sudan, Somaliland, Ethiopia, Libya, French Sudan, Persia.

Ecological notes. Prefers sandy soil. One of the pioneers on sand dunes.

13. **Indigofera angulosa** Edgew. ex Baker in Hook. f. Fl. Brit. India 2 : 97, 1876.

Description : Duthie Fl. Upp. Gang. Pl. 1 : 252-253, 1903. This description should be supplemented thus : leaflets generally 5, rarely 3, mucronate ; pods often 4-seeded ; seeds concave with a raised ridge in the centre.

Specimens examined. Ajmer : *V. S. Sharma* 8, 831.

Flowering period. July-August, December-February.

14. **Indigofera wightii** Grah. ex W. & A. Prodr. 202, 1834.

Description : Cooke, Fl. Pres. Bomb. (Reprint) 1 : 340, 1958.

Specimen examined. Sikar : *Natawath.* The label is incompletely filled and the specimen not properly preserved.

Distribution. Throughout India ; Ceylon.

Flowering period. October.

15. **Indigofera tinctoria** Linn. Sp. Pl. 751, 1753. *I. indica* Lam. Encycl. Meth. 3 : 245, 1789. *I. sumatrana* Gaertn. Fruct. 2 : 317, t. 148, f. 4, 1791.

Description : Duthie, Fl. Upper Gang. Pl. 1 : 254-255, 1903. This description should be supplemented thus : seeds separated by septa, cylindric, dotted brown.

Specimens examined. Anand Sagar : *Vasavada* 4088. Ajaysagar : *V. S. Sharma* 84. Foysagar : *V. S. Sharma* 195. Khetri : *Kanodia* 225, 254. Pilani : *Koshy* 11, 12.

Distribution. Throughout India, Ceylon, Burma, Indonesia, Philippines, Siam, Indochina, Malaya, W. Pakistan, Tropical Africa, Florida, W. Indies.

Flowering period. Mostly during the rainy season, but may continue up to December.

Ecological notes. Gregarious. Often forms pure associations in stable soil as well as on hill slopes.

16. **Indigofera glabra** Linn. Sp. Pl. 751, 1753. *I. pentaphylla* Murr. Syst. Veg. ed. 13 : 564, 1774.

Description : Cooke, Fl. Pres. Bomb. (Reprint) 1 : 337, 1958.

Specimen examined. Sikar : *Natawath.* An unnumbered and improperly preserved specimen.

Distribution. Throughout India ; Tropical Africa.

Flowering period. October.

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The Bats of Central and Western India

PART IV

BY

A. BROSSET

(*With three text-figures*)

[*Continued from Vol.* **59** (3) : 746]

This fourth and last part deals with certain general aspects of the biology of Indian bats, mainly their zoo-geographical affinities, ecology, reproduction, and hibernation. More detailed papers on their reproduction and hibernation are under preparation and only a a summary is given here.

ZOO-GEOGRAPHICAL AFFINITIES OF INDIAN BATS

The theories concerning the zoo-geographical origin of the different species of bats admit of a large amount of speculative uncertainty. However, if we consider, not the species or even the genus one by one but, the whole fauna of bats of a given area, their zoo-geographical affinities appear more clearly. Table I below gives the general distribution of the genera represented in western and central India. Most of these genera have an immense area of distribution; not a single one is specifically Indian. This table shows that it is not possible to deduce the affinities of Indian species from the examination of the distribution of the genus. Table II shows the distribution of the Indian bats at species level. The zoo-geographical affinities of the Indian bats appear clearly at this level and Indian species can be classified in several groups:

(i) *Species having their centre of distribution in the deserts of Africa and Asia:* The two species of *Rhinopoma* and probably *Taphozous kachhensis.*

(ii) *Species having their centre of distribution in the arid areas of eastern Africa:* They are *Taphozous perforatus* and *Tadarida aegyptiaca.*

TABLE I

GENERAL DISTRIBUTION OF THE GENERA OF BATS IN WESTERN AND CENTRAL INDIA

Rousettus Tropical Asia and Africa.	*Pteropus* Tropical Asia, Madagascar, Australia.	*Cynopterus* Southern Asia and Malaya.	*Taphozous* Tropical Asia and Africa.	*Rhinopoma* Arid areas of Asia and Africa.
Megaderma Southern Asia with closely allied genera in Africa and Oceania.	*Rhinolophus* Practically all over the Old World.	*Hipposideros* Tropical Asia and Africa.	*Tadarida* Tropical and arid countries of the five continents.	*Otomops* Tropical Asia and Africa, Madagascar, and Oceania.
Pipistrellus The whole Old World and North America.	*Hesperoptenus* Southern Asia.	*Scotophilus* Tropical Asia and Africa.	*Tylonycteris* Tropical Asia.	*Myotis* Practically the whole world.
Miniopterus Europe, Asia, Africa, Oceania.	*Kerivoula* Tropical Asia and Africa.	..	..	..

TABLE II

GENERAL DISTRIBUTION OF THE SPECIES OF BATS OF WESTERN AND CENTRAL INDIA.

Rousettus leschenaulti India to Indo-China and Java.	*Pteropus giganteus* India, Burma, and Ceylon.	*Cynopterus sphinx* India to Java.	*Rhinopoma microphyllum* Deserts and tropical arid areas of the Old World.
Rhinopoma hardwickei Perhaps the whole Sahara, deserts of Asia, Egypt, the greater part of India, Siam.	*Taphozous perforatus* Arid areas of eastern Africa, deserts of Asia to Gujarat.	*Taphozous melanopogon* India to Borneo.	*Taphozous saccolaimus* India to Sumatra.
Taphozous theobaldi India to Java.	*Taphozous kachhensis* Perhaps various parts of the deserts of the Old World, India, Malaya.	*Taphozous longimanus* India to Borneo.	*Megaderma spasma* India to Borneo.
Megaderma lyra India and Burma.	*Hipposideros bicolor* India to Formosa.	*Hipposideros speoris* India to Borneo.	*Hipposideros lankadiva* India and Ceylon.
Hipposideros galeritus India to Borneo.	*Rhinolophus rouxi* India and south of China.	*Rhinolophus lepidus* India and Malaya.	*Rhinolophus luctus* India and Borneo.
Tadarida aegyptiaca Egypt, Kenya, western India.	*Otomops wroughtoni* India.	*Pipistrellus mimus* India and Annam.	*Pipistrellus coromandra* India and Indo-China.
Hesperoptenus tickelli India and Ceylon.	*Pipistrellus ceylonicus* India to Indo-China.	*Pipistrellus dormeri* India to Formosa.	*Myotis peytoni* and *M. peshwa* India.
Kerivoula picta India to Borneo.	*Tylonycteris pachypus* India to Sumatra.	*Scotophilus kuhli* and *S. wroughtoni* India to eastern Asia.	*Miniopterus schreibersi* France to Australia.

(iii) *Species having their centre of distribution in south-eastern Asia:* They are the great majority: *Rousettus leschenaulti, Pteropus giganteus, Cynopterus sphinx, Taphozous melanopogon, T. saccolaimus, T. theobaldi,* and *T. longimanus, Megaderma spasma,* and *M. lyra, Hipposideros bicolor, H. speoris, H. lankadiva,* and *H. galeritus, Rhinolophus rouxi, R. lepidus,* and *R. luctus, Pipistrellus mimus, P. ceylonicus, P. coromandra,* and *P. dormeri, Hesperoptenus tickelli, Kerivoula picta, Tylonycteris pachypus,* and *Scotophilus kuhli,* and *S. wroughtoni.*

(iv) *Purely Indian species: Myotis peshwa* and *M. peytoni,* and *Otomops wroughtoni.* These species are rare and perhaps inhabit other areas, where they have not been studied.

(v) *Cosmopolitan species:* A single one—*Miniopterus schreibersi.*

The bats in India appear to be essentially oriental, with a few species originally from eastern Africa and the deserts of the tropical areas of the Old World. India forms the meeting place between two types of fauna, the bats from Rajasthan, Gujarat, and western Madhya Pradesh belonging to the western world, and the rest of the country being inhabited by oriental species. This difference is evidently determined by ecology—north-western India forming the eastern border of this immense arid area extending eastwards from Mauritania, the rest of the country belonging to the oriental region of Asia.

It may be noted that the zoo-geographical origin of bats in India recalls that of birds in the same area (cf. Dillon Ripley). It would appear that these two groups of flying vertebrates evolved along parallel lines adapting themselves to prevalent ecological conditions.

ECOLOGY

Every nocturnal species has two kinds of biotopes: the diurnal roost, where the individuals rest and sleep, and the nocturnal territory where they search for their food. According to the species, their social activities occur in the diurnal or the nocturnal territory. Most species of bats have very precise requirements for both diurnal and nocturnal biotopes.

(*a*) The diurnal roost: The existence of suitable diurnal biotopes is a very important factor in the ecology of bats. In India species living in cracks and trees easily find shelter. But the highly gregarious species, which live in cavities in large colonies, need caves or decayed buildings, which do not exist all over the country. The abundance or absence of species like *Taphozous*, for instance, is linked with the presence of old palaces, hypogean temples, or cliffs with large crevices.

Indian bats have two types of roosting biotope: cavities, and the open air.

1. Cavities

Four types of cavity are inhabited by Indian species: (a) caves; (b) deserted buildings; (c) crevices of cliffs, walls, and wooden structures; and (d) hollows in trees.

(a & b) *Caves and deserted buildings:* The same species inhabit caves and the interior of buildings and are of the genera *Taphozous, Rhinopoma, Rhinolophus, Hipposideros,* and *Megaderma.* During the day, they hang by their hind limbs from the ceilings like cocoons (*Rhinolophus, Hipposideros*), or keep themselves hooked by the fore limbs against the walls (*Taphozous*).

The artificial caves carved by the Hindus and the Buddhists have provided many suitable biotopes. In fact, natural caves do not occur in the coastal areas and in the Deccan. Before the caves and temples were made by man, the species of *Taphozous, Rhinopoma,* and *Megaderma* only had the cracks in the cliffs, which are not numerous in western India, as their diurnal roosts. But now, probably over many centuries, these species have no doubt occupied the many artificial caves and hypogean temples, which today form the most suitable and accessible places in India in which to study them.

Let us see what are the factors favourable to the settlement of bats in caves and buildings. A large cavity is not a strict necessity, and the size of the room is of secondary importance. For instance. I saw in Chikalda hundreds of *Rousettus* roosting under the dome of a small isolated dungeon. The whole surface of the ceiling was covered with bats. In the cave at Alibag, *Taphozous melanopogon* were in low recesses, almost at the level of the ground. Colonies of *Hipposideros* have been observed in holes of foxes and porcupines. But an important factor is the existence near by of other caves where the bats may find shelter when they are disturbed during the day in the main habitat. In fact, if bats like *Rousettus* or *Hipposideros* are chased from a cave into the open air, they are attacked by kites and crows and must quickly reach another place of safety. For this reason, large colonies are most often found where the caves are numerous, with ramifications and recesses.

This darkness is no doubt a favourable factor, but perhaps more important is the quietness which usually prevails in dark places. For instance, the colonies of *Rhinopoma microphyllum* of western India spend the day in well-lit porches, at the entrances of caves and ruins. They take shelter in the darker parts of the diurnal habitat only if they are disturbed. Similar observations may be true of *Taphozous* and *Megaderma*.

A high degree of humidity is required by the palaearctic species living in caves, and they do not frequent the dry cavities. This need of humidity is certainly connected with periods of hibernation which may extend to six months and more in cold countries. In India, these conditions do not exist and many species live in relatively dry cavities. *Rhinolophus rouxi* appeared to be an exception, and was always found in humid caves. Generally speaking the Rhinolophids are known for the fragility of their wing membranes; if the bat is kept in dry air, the wing membranes dry quickly and the bat dies.

Tranquillity affects different species differently. *Rousettus leschenaulti* is very intolerant and abandons its diurnal roost easily and definitely if it is disturbed. Twenty years ago, the colony at Khandala deserted the railway tunnel after Br. Navarro took some specimens there. In 1961, the Archaeological Department carried out some work in the vicinity of the large colony at Elephanta with the same result.

On the other hand, the elimination of *Taphozous* and *Rhinopoma* from the caves of archaeological interest is a difficult enterprise. These species refuse to abandon their diurnal roosts, even when much disturbed. The cracks and other small inaccessible cavities adjacent to the main caves or hypogean temples give temporary shelter to the disturbed members, which return to the original place as soon as the immediate cause of disturbance has passed. Many well-known places, e.g. Ellora, Ajanta, and Agra, are full of *Taphozous*, and the Archaeological Department have been unable to do anything better than continue to pay numerous scavengers to sweep away the guano.

Finally, we may say that bats in India can be found in all types of caves and old buildings. Caves are relatively not numerous in India and, the choice being restricted, practically every cavity gives shelter to populations of bats.

(c) *Cracks and crevices:* This type of biotope is peculiar to a group of species which need to have both their back and belly closely in contact with the surface of the wood or the stone. This 'chasmotropism' is usual in the Molossid family (*Tadarida, Otomops*).

The individuals of these species introduce themselves in narrow crevices of the buildings, cliffs, ceilings of caves, timber work, etc., and their reactions to disturbance is not to fly away, but to draw back into the deeper parts of the cracks or crevices. Similar habitat and behaviour are also characteristic of several Vespertilionidae, e.g. *Pipistrellus, Scotophilus, Myotis,* etc.

For instance, the *Pipistrellus*, which are far the most numerous and the commonest bats of India and of the Old World, live in the roofs of buildings especially under the tiles, and also under the blinds, behind picture frames on the walls, etc. *Tadarida aegyptiaca* inhabits deep crevices of the cliffs (Aurangabad) or of old buildings (Poona, Mandu, Agra). Humayun Abdulali told me that he had found one specimen of *Tadarida* sp. (?) on the ground, under a stone on a small islet off the Malwan Coast, south of Bombay[1]. Such type of biotope, although probably rare in India, is well known in certain African bats of the same genus. *Otomops wroughtoni* inhabits deep crevices and the upper portion of large funnels in the ceiling of Barapede Cave. This heavy bat has very narrow wings, and has to let itself drop down from a height before it can fly off. Usually the species of the genus *Tadarida* have the same requirements.

The *Pipistrellus* are much more numerous around villages and towns than in the country. They have taken great advantage of man's presence by colonizing his houses. All these species have little to fear from human beings. The owners of the houses inhabited by *Pipistrellus* pay no attention to their presence. *Tadarida* and *Otomops* are not common species in India; they are difficult to find and to capture, and human interference in their life is very rare.

(d) *Hollow trees:* In various parts of the world, hollows in trees form the normal diurnal roost for many species of bats. I have myself had the opportunity to verify this in Africa and South America. In India, except perhaps in large forests, this is not so, and the bats inhabiting decayed or hollow trees are few. Some *Pipistrellus* were observed in crevices of tree trunks, and a few observations show that *Taphozous saccolaimus* spend the day in decayed palm trees. In Kanara, Shortridge found two species of *Rhinolophus* in hollows of trees. *Tylonycteris pachypus* is known to roost inside decayed bamboos.

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[1] In Vol. 26 of the *Journal* at p. 824 Inglis *et al.* in ' A tentative list of the vertebrates of the Jalpaiguri District, Bengal ' record *Myotis muricola* as common ' under stones in the bed of the Torsa river '.—Eds.

2. **Open air**

In Central and South America, numerous species inhabit the open air during the day: surface of rocks, foliage, branches of trees, etc. In the Old World, this type of biotope concerns only a few species, none in the palaearctic, perhaps a dozen in Africa, and only three or four in India. The best known is *Pteropus giganteus*, an arboreal species, very common everywhere, especially on trees in the middle of villages. In Gujarat, *Taphozous longimanus* often roost on the external walls of houses. Finally it seems that *Kerivoula picta* and *Hesperoptenus tickelli* live in trees, probably concealed among the leaves during the day, but precise information is not available.

(*b*) The nocturnal feeding territory: According to the ornithologists, competition for food between the various species of birds living in a given area is unimportant, or even non-existent, because each species has its own type of food or has a special feeding area and does not encroach into the territory of the others. The rule does not seem true everywhere, especially in the tropical forests of America (or even of India) where numerous closely allied species of birds having a similar morphology and diet live side by side. Nevertheless, the theory of Ecological Niches is useful and helps to explain the exploitation of the food available in a given biotope.

During the night, the hunting territories of birds are occupied by the bats. Have they in the same manner exploited the various possibilities of the biotope for their food? Are their morphological differences associated with their special diet or methods of hunting as in the birds? An affirmative reply can be given to both questions.

The hunting territories of insectivorous Indian bats are of three main types: (a) the open air; (b) amid the foliage of trees; and (c) on the surface of rocks and on the bark of trees.

The frugivorous species have two types of feeding territory, not so well marked as those of insectivorous species:

(i) At the top of large fruit trees (*Pteropus*);

(ii) Among the lower branches and bushes (*Rousettus* and *Cynopterus*).

(a) *Species hunting in the open air:* Such species are the majority. They explore large areas of air, searching for insects which fly out at sunset and at night. They are essentially the Vespertilionidae, Emballonuridae, and Molossidae. But the hunting territory is not exactly the same for the different groups.

The *Pipistrellus* and *Scotophilus* of the Vespertilionidae usually hunt at middle heights, between trees and buildings. The territory is more or less the same as is worked during the day by flycatchers.

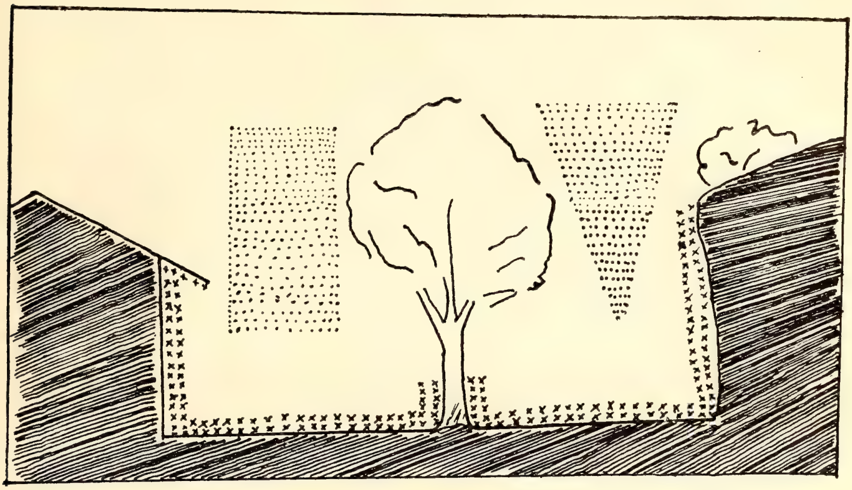

Fig. 1. ∴ Hunting territory of *Pipistrellus, Scotophilus,* etc.; xxx xxx Hunting territory of *Megaderma*

The *Taphozous* and Molossidae hunt higher above the ground, and explore the aerial open fields. They have during the night the territories of the swifts and the swallows.

(b) *Species hunting amid the foliage of trees:* The *Rhinolophus* belong to this group. They search for insects both flying and settled on the leaves and branches. They occupy during the night the territory of the warblers (Sylviinae) during the day.

(c) *Species exploring the ground, or the surface of rocks and barks of trees:* The *Megaderma* have this special hunting biotope where they search for terrestrial insects and small vertebrates. The feeding territory is similar to those of the shrikes, rollers, and the smaller birds of prey. The *Hipposideros* hunt over similar territory, not far from the ground and around the bushes.

RELATIONS BETWEEN THE MORPHOLOGY OF THE SPECIES AND THE NATURE OF THEIR FEEDING TERRITORY

The comparison with birds can be continued further. In the same way that the wings of warblers differ from those of the swifts, some bats have broad and short wings while others have them long and pointed. These differences, corresponding to the nature of their

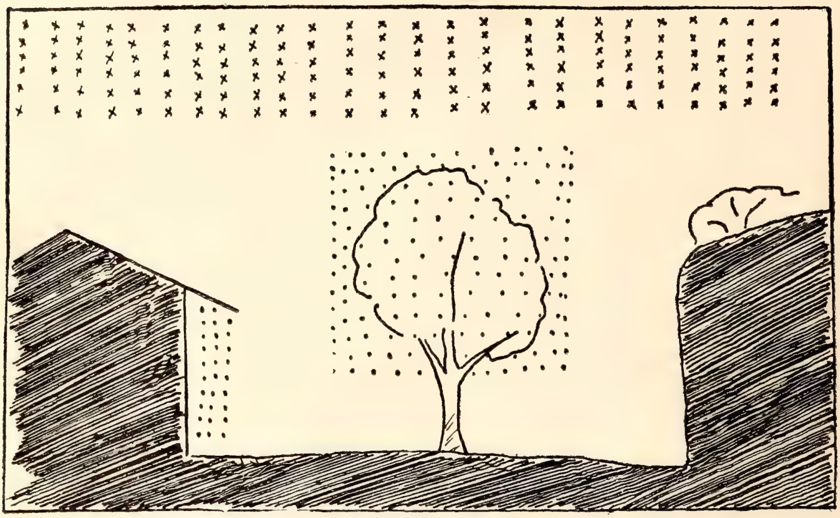

Fig. 2. ⁘ Hunting territory of Rhinolophidae ; xxx xxx Hunting territory of Molossidae and Emballonuridae

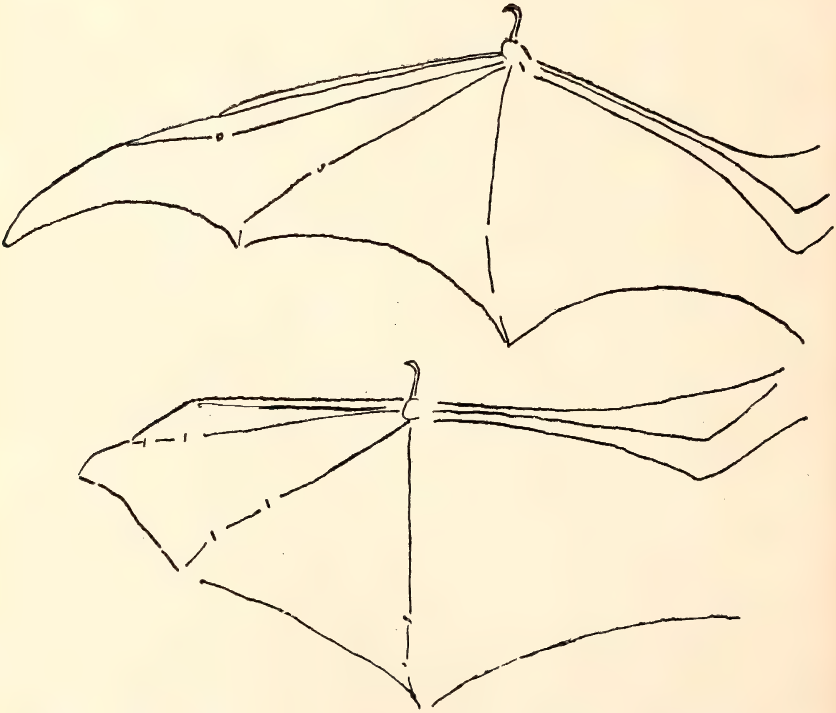

Fig. 3. *Above* : Wing of a strong flyer, *Taphozous saccolaimus* ; *Below* : Wing of a weak flyer, *Rhinopoma microphyllum*

respective feeding territories, are attained by changes in the length of the third finger, as illustrated in the accompanying sketches.

REPRODUCTION

Study of the reproduction of bats is important to understand their general biology. Their sexual life can give an explanation of many aspects of behaviour, including cycles of displacement and their social life so peculiar in different species of Chiroptera. However, until recent years, methods and details of the reproduction of tropical bats remained unknown and mysterious. Several important studies have now shed light on the main aspects of the reproduction of Asian and African species. For Africa, Verschuren had given data of considerable value. For Asia, the placentation and sexual cycles of several Indian species are known by the important work of Moghe & Gopalakrishna, and their students. I have myself been able to obtain much information on the reproduction of Indian bats. My notes, in comparison with the researches of the Indian authors, may appear superficial, especially in relation to spermatogenesis and duration of pregnancy, because they lack the histological basis. On the other hand, I obtained in the natural environment data which would not be available in a laboratory. For this reason, I think these different studies will help to supplement and complete each other.

(*a*) Secondary sexual characters: Several Indian species have curious secondary sexual characters which are not easily visible in the skins preserved in museums. For this reason, the descriptions of the older authors are often incomplete, sometimes erroneous. The question needs to be re-examined with fresh specimens.

It may be noted that such characters sometimes occur in both sexes, sometimes in the males alone. In India they are not seasonal but permanent in all species, appearing after the juvenile stage, and sometimes well before sexual maturity is attained.

1. *Erectile beard:* The black beard appears in the young of *T. melanopogon* when about six months old (observations made in Kanheri). In the same time, the fur becomes lighter, of a sandy grey colour. This black beard is a good field character for the identification of the species in its diurnal biotope, and the more because the bat bristles up its beard when excited or frightened.

Six adult males of *Taphozous theobaldi* caught in North Kanara in May 1961 show a beard of the same type, but rufous and not black.

2. *Gular pouch:* Males of *T. longimanus* possess a very large inter-mandibular pouch (known as the inter-mandibular organ of Schaffer). The females also have the pouch, but less developed. A gland in front of the pouch produces a fatty and reddish secretion, with a strong and disagreeable smell; the same type of gland is present in *T. perforatus* and *T. kachhensis.* The gular sac appears early, being noticeable in the juvenile stage in *T. kachhensis.*

3. *Pectoral gland:* This gland is round and well developed in the male of *Taphozous kachhensis,* and absent in the females. Both sexes of *Otomops wroughtoni* have a deep and large gland at the base of the throat.

4. *Frontal sac:* Well developed in the males of *H. speoris* and *H. galeritus.*

5. *Variations in the colour of the fur:* Large variations have been noticed in the colour of the fur in several Indian species. In most cases, this polymorphism is unconnected with the distribution of the bats, and arises from purely individual variations of no taxonomic value. Several of the well-differentiated types of colour can be observed in individuals of the same colony, and we saw that Indian subspecies named on such differences cannot be sustained.

Colour variations may be due to age; except in *Pteropus* the young of all species, are grey. The true colour of the adults appears in the smaller species, after six months. Sexual dimorphism exists in three Indian species. The adult male of *C. sphinx* has bright rufous upper parts (sometimes the females also). The males of *R. leschenaulti* have the sides of the body washed with grey, the female being yellowish all over. The females of *T. melanopogon* are darker and browner than the males.

Finally, we do not know the reason for most of the variations of colours of bats. For instance, a red type is known in numerous species which are usually brown. *Tadarida aegyptiaca, Otomops wroughtoni, Rhinolophus rouxi, Hipposideros lankadiva,* and *H. fulvus, Pipistrellus ceylonicus,* and *Miniopterus schreibersi* have both types represented in the same colony. These phases of colour appear to have no connection with season or sex. Their biological significance remains to be elucidated.

(*b*) Periodicity of reproduction: Data have been collected on the reproduction of twenty-seven species. The greatest number have a well-marked periodicity. All the adult females of a given species give birth to their young during one or two short periods regularly the same in the annual cycles. These dates vary from one species to another, but not for the individuals belonging to the same species.

In the state of our knowledge, unfortunately incomplete for several species, it seems that bats have three types of periodicity in India:

1. *One short and single cycle in the year—the young being born in a precise and restricted period:* This type of periodicity occurs in the great majority of Indian bats.

2. *One cycle in the year, but very long (March to September):* The greater number of females deliver in March, but others continue through the summer. This is the case with the small frugivorous bats and certain species of *Pipistrellus.*

3. *Cycles of reproduction free of the rhythm of the season, and following one another without stop:* One single species shows this type of cycle—*Taphozous longimanus.*

The analysis of the internal and external factors which determine the cycles of reproduction of the Indian bats show that the periodicity is firstly determined by the phylogenetic origin of the species; for instance, all the Indian Rhinolophidae (8 species) give birth to their young in spring, but the Molossidae do so in autumn. On the other hand, climatic factors particularly the rains in tropical countries may also be an important external factor in the determination of the time of their birth. In Africa and Asia, the majority of the species give birth to their young before the start of the rains, or just at the same time (cf. Verschuren for Africa, and Brosset for India).

(*c*) Sexual maturity, mating behaviour, pregnancy: I give here a summary of my notes published in another paper (cf. Brosset, La reproduction des chiroptères de l'Ouest de l'Inde. *Mammalia,* June 1962).

The small insectivorous bats, like *Hipposideros speoris* and *H. bicolor,* reach sexual maturity when 18-20 months old. Young individuals ringed in autumn in Elephanta were still immature the next spring. But one juvenile female ringed at Elephanta on 15 November 1959 (Bombay Nat. Hist. Soc., Ring No. 1357) gave birth to one young in May 1961. Owing to their slow development, the sexual maturity of the fruit bats probably takes longer.

Most activities of the bats are nocturnal and, owing to difficulty of observation, the sexual behaviour of this group of mammals is practically unknown. The biological significance of pairs of bats resting or flying together is of little importance as very often the two individuals of the pair are found to be of the same sex. The copulation of *Megaderma spasma* was observed during the night in January 1961 at Kanheri. The male overlapped the female *modo ferrarum*. Each was hanging from the ceiling by a single foot only, and the hind part of their bodies was turned to the side, so that the two pubes were face to face. The free foot of each individual was used to hold the body of the other, probably in order to maintain the contact. It seems that the position of bats during copulation shows variations related to the systematic position of the species. Pairs of *Taphozous melanopogon* were seen in Kanheri in the position of copulation normal in most species of mammals.

The pregnancy of some Indian species has been studied carefully by Moghe & Gopalakrishna. These species belong to purely tropical groups of bats. Some new studies of bats belonging to the genera *Myotis* and *Rhinolophus* are needed in order to determine if they show in tropical countries such phenomena as delayed fecundation, or slackened pregnancy, as in the palaearctic regions.

In France, Courrier has proved that in *Miniopterus schreibersi* the foetus stops growing in winter and the pregnancy extends over about eight months. It seems the same occurs in India in this species. In the Robbers' Cave, I noticed that the pregnancy of this small insectivorous bat has a duration of at least five months.

(*d*) Number of young. How mothers carry young. Juvenile mortality: With a few exceptions, bats give birth to a single young. It is the rule for the whole order Chiroptera. In India, hundreds of *Taphozous, Rhinolophus,* and *Hipposideros* were seen carrying a single young, and no case of twins was noticed.

One case of twins has been recorded by Moghe in the fruit bats in *Cynopterus sphinx*. Twins seem rather frequent in *Megaderma spasma,* and are the rule for the Indian *Pipistrellus* and *Scotophilus.*

During growth, the position of the young varies according to the anatomy and ecology of the mother. In *Megaderma, Rhinolophus, Hipposideros,* and probably *Rhinopoma,* the young is carried by the mother in an inverted, ventral position. This position, which serves to give a good balance to both, is associated with the existence in the mother of the pubic false dugs to which the young affix themselves firmly by the mouth. The mother can fly with a young almost as big as herself. The other groups of bats have no false dug. In the fruit bats the position of the young is ventrally parallel. The young is affixed to the natural dug with the body crossing the belly of the mother, so that she can carry a large young and fly with a good equilibrium. The species belonging to the genus *Taphozous*, and probably also the *Tadarida*, keep their belly in permanent contact with the stone surface of their diurnal roost, and the young cannot be accommodated under the belly; so the young are displaced to the side, under the wing. The mother cannot fly with a large young in such a position. Contrary to the previous species, the young of *Taphozous melanopogon* leave the mother early, being able to fly a long time before reaching adult size. In *Taphozous kachhensis* the young has found another position. It keeps itself on the back of the mother. Probably in the great majority of bats, the young is reared by its own mother. But in *Miniopterus schreibersi* the mother does not carry and suckle her own young. All the young are put together in a special cluster and reared by the community of the females. (For development and pictures of this behaviour, see Brosset, La reproduction des chiroptères Tropicaux. *Mammalia*, Tome **26**, No. 2, June 1962.)

Due to especially good conditions I was able to study the juvenile mortality in *Taphozous melanopogon* and *Rousettus leschenaulti* at Kanheri. In *Rousettus* about one-fourth of the young die in the early stages; in *Taphozous* one-fourth at the time of the separation from the mother (forearm 50-54 mm. in length for 34 dead young collected).

(*e*) Reproduction and social life: Recent researches have shown that the social life of the European species covers a short part of the sexual cycle. After fecundation the sexual segregation occurs and males and females live in separate roosts. Even the seasonal movements, which affect the two sexes differently, are under the influence of sexual rhythms. Unlike in the palaearctic area, in India such behaviour does not seem to be the rule. The segregation of the sexes is exceptional. In the great majority of species males and females live together the whole year. In addition to the colonies where both sexes are completely mixed, one can meet in India a second type of colony where males and females live in the same diurnal roost but in separate groups. This type of colony was observed in *P. ceylonicus*, *Rh. lepidus*, and *T. melanopogon*. In these species, the males are frequently scattered around a nucleus of females, sometimes several colonies of males occupying secondary diurnal roosts in the vicinity of the main roost, where only females may be found. These observations show that among bats, the females are dominant, and occupy regularly the better and safer portions of the biotope.

The only species in which a rigorous segregation of the sexes in India is proved is *Rhinolophus rouxi*, though two cases of segregated colonies were observed in *Rhinopoma hardwickei*.

In colonies where males and females live together, the sex ratio is far from balanced. In fact, with a few exceptions, the females are more numerous than the males. In India, the fact was brought to light for the first time by Humayun Abdulali (cf. *J. Bombay nat. Hist. Soc.* **48** : 423-427; 1949). For various countries, the same observation has been made by numerous authors. Baker & Bird 1936, Blanford 1888, Brosset & Caubère 1950, Casteret 1938, Gopalakrishna 1947, 1950, Ramakrishna 1951, Nimsatt 1945, etc.

What is the reason for this unbalanced sex ratio in bats? The only species for which sufficient statistical data are available is *Miniopterus schreibersi* in France. In the colony of Rancogne 1747 newly born were examined, of which 877 were males and 870 females. The sex ratio is equal at the time of the birth of the young. Nevertheless, adults caught at the same place showed 897 females against only 700 males. We saw that, for this species, both sexes live together indiscriminately mixed, and the higher mortality of the males does not appear to be connected with any ecological factors. The explanation for this unbalanced sex ratio in bats may lie in physiological factors, connected with sexual endocrinology.

HIBERNATION

In temperate and cold countries, bats hibernate. This hibernation often broken by short periods of activity is practically continuous from October to April in middle Europe, where bats are known to hibernate even in summer. Practically nothing was known about the hibernation of bats in tropical countries, and I made special efforts to ascertain if such behaviour could be observed in Indian species. For this reason the degree of activity of all individuals observed was noted. Bats found in a state of torpidity were caught, and their reactions carefully observed. Experiments were made to ascertain whether hibernatorial faculties existed in species which did not hibernate under natural conditions. Twelve species were experimentally tested by repeated cooling.

Observations in the field throughout the year prove that the species belonging to the group of the fruit bats and also of the genera *Taphozous*, *Rhinopoma*, *Megaderma*, and *Hipposideros* never hibernate in natural conditions. Probably, it is the same for the Molossidae, *Tadarida*, and *Otomops*. On the other hand, the various species of Indian Rhinolophids and Vespertilionidae were frequently found all over western India in a state of complete hibernation.

The cooling experiments were made with a refrigerator, where bats were placed, each in a bag, a short time after their capture (internal temperature 8° C.; duration of the experiment: from 6 to 36 hours; control of tested individuals: they were examined on an average once every five or six hours—for a detailed account of these experiments, see Brosset: L'hibernation chez les chiroptères Tropicaux. *Mammalia*, Tome **25**, No. 4, December 1961).

During these experiments, four types of reactions were noticed:

(i) The bats tolerate the cooling experiment, do not enter into any hibernatory stage, and fly away easily immediately after 24 hours of experiment. Various *Taphozous*, *Megaderma*, and the larger *Hipposideros* showed this type of reaction.

(ii) After a period of restlessness, the bats enter into complete hibernation; at the end of the experiment (24-36 hours) the bats recovered progressively (in periods varying from 15 to 30 minutes) the normal state of activity, and did not seem to suffer from the experiment. *Rhinolophus* and Vespertilionidae showed this type of reaction.

(iii) After a few hours, the tested individuals entered a state of torpidity which looked like hibernation, but from which they did not recover and died. *Rousettus leschenaulti* reacted in this manner to the cooling experiment.

(iv) The tested bats did not endure the cooling experiment and died after a few hours. The small species of *Hipposideros* showed this reaction.

Two important facts are established by these observations and experiments:

(*a*) The hibernation of the Chiroptera is not entirely connected with the thermic regulation of the body; it may be due to causes other than climatic conditions. Tropical species pass through periods of complete hibernation, Palaearctic species are frequently found hibernating in summer, and the same type of hibernation has been observed in rodents, and even in birds. The Hummingbirds of the Andes, which sleep in caves during the night, have a rhythm of torpidity independent of the external variations of temperature. Further, the hibernatorial rhythms are individual; bats in a state of complete hibernation may be found resting beside others of the same species in a state of absolute activity.

(*b*) The field observations strengthened by experimental research and by data recorded in Africa show that bats like *Taphozous, Megaderma, Rhinopoma,* and *Hipposideros,* which do not possess hibernatorial faculties, are restricted to countries with warm winters, i.e. the tropical and equatorial areas. The Rhinolophids and Vespertilionids, which all hibernate, have been able to settle in temperate and cool countries. It seems that the presence and/or absence of hibernatorial faculties in the different groups of bats has determined their distribution over the world.

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I cannot conclude this paper without once more thanking Mr. Humayun Abdulali for the help he has given me throughout the course of its publication. He kindly revised the entire manuscript, an office rendered very necessary by my imperfect knowledge of the language, and he has made many corrections in the text which I was not able to make myself because, among other things, I was not within range of the mail.

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Chapters on the History of Botany in India

VII. EPILOGUE

BY

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[*Continued from Vol.* **60** (1) : 83]

My narrative is finished. In the years round about 1900 India reached a kind of culmination to her very gradual entry into the comity of nations using an elaborated philosophy and an accepted vocabulary for intercommunication—the Language of Botany. India in that had become prepared to face and answer her questions in Botany by the founding of schools and above all in the possession of her own laboratories. The story of the slow progress is made peculiarly interesting by the circumstance that the majority of those who took part in making the progress entered into it with their botany as a release or pastime in dull hours—the more credit to them. It was in admiration that I prepared myself to write of them. They were men of action. Education, however, be it said, combined with their circumstances in determining the direction that their energy took. At the end of this my last chapter, it is suggested that the implanters of the science were chiefly surgeons.

Before I close, I have two matters which I wish to bring to my reader's notice. The first is actually part of the contributors' aptitude to which I have alluded. It refers to regional ease or adverse difficulty of getting pleasure. A mountaineer cannot enjoy his bent without the mountains; a botanist needs his magnet—a manageable and attractive flora, at least for his beginnings; and my reader will find, connected with the name of Linnaeus, my interpretation of the cause of reasoned plant taxonomy having had its development among herbalists who were not confronted with the handling of the profusion of a tropical flora. My reader doubtless realises that I am pointing out to him one of India's handicaps.

1. SOME PHYTO-GEOGRAPHICAL CONSIDERATIONS

I draw my reader's attention now to a phyto-geographical matter ripe for work—it is full of interest and full of openings for work.

Hooker's last writing on India led to it, namely his essay in the IMPERIAL GAZETTEER on plant distribution; but Hooker had not the material that he wanted, and the account is imperfect though he gave a useful lead by analysing certain provincial floras of India. In my chapter 6, by rearranging part of his data, I have drawn attention as far as seemed desirable in that place to the contrasted sward and forest sides of India.

Accompanying the contrasts in India's natural vegetation are the contrasts of India's cropping. Naturally the crops have called out much attention but not yet enough. The history of the crops and the history of the climates should be brought to a common footing. Man's part in evolution had thereby received light. The belt between sward and forest has been pushed eastwards since it became recognizable as the Glacial Ages ended.

Let us see what is believable of it at its earliest. The Glacial Period had great alternations of cold and fertile temperatures—for clarity disregard this and think only of the end. Geographically the last great and extensive glaciation followed the other quaternary glaciations (some greater) and all inflicted their damage on the evolution of the northern vegetation of the Globe. That is a fact which makes it convenient to draw attention to the passing away of the last Pleistocene destruction by the spread of a condition which must have killed much and spread herbs rather than trees, so that the afflicted areas recovered through herbs. In the place of snow, expanses of tundra were formed; and what interests us in them is that in time they became the feeding grounds of herds of mammals—we may picture cattle, and deer of various species, asses and their relatives, and mammoths. This abundance caused such forms of mankind, as were in a position to associate themselves, to live by hunting, and they became intensely carnivorous. As the tundra moved backward, so did the herds and the hunting men. There came times, more particularly in some parts than in others, when the complex was squeezed out. It was then that pastoralism entered and with the increasing squeeze came the entry of more and more herbs into the diet.

2. MAN THE HUNTER BECOMES MAN THE AGRICULTURIST

Whatever happened, Man was compelled to have resting places and more or less repeatedly occupied spots; and at these the seeds that he scattered by bringing food home fixed his interest on certain plants. I envisage Barley as among the first in the Old World, with

Wheat following up, but more local and believably later. Man would learn to increase the availability of what he used most, encouraging the self-grown annuals about his settlements to grow to usefulness. Man in this phase might even imprison a cow in milk for a short period; but neither act was more than pre-agriculture. Genuine agriculture must be dated as of a later time, when whatever was done was *habitual over seasons,* i.e. when Man became involved in promoting the reproduction of what he fed on; as to plants, it was by tilling. Tilling required tools, and is to be dated by them. As the potters found possible the manipulation of copper and then the making of bronze, hope of something better than stone for the tiller dawned; and the use of iron completed the triumph. This triumph was the vegetarian feeding which is our chief interest here.

From the evidence of the geologists on the passing of Ice, from the evidence of the availability of copper ore and later other metals, from the searches of the archaeologists for tools in old inhabited places, and from what botanists prove to have been used as food and where this was, it is proved that primitive Man never made greater progress in real agriculture than in the south-western part of Asia. Pliny echoed what must have been a belief of his time that Barley was leading—a not impossible thing. We have evidence that population and therefore food-production had a great increase squeezing down onto Mesopotamia; then Sumeria, escaping the greatest, aided the accepting of Barley and also of Wheat in the lands of northern India, to meet there the copper for spades and to be joined there by Rice in a way to be explained. I shall proceed to explain it; but there is an interesting observation on the passing of an excessively carnivorous to a more vegetarian condition which I desire to intercalate.

There are in caves in southern France beautifully executed drawings of deer which can be dated as Upper Palaeolithic, as they were the work of Magdalenians. They are interpreted as done for calling the deer; for the Magdalenians were suffering from loss of flesh for which they hunted. Leaving that, I take my reader back to Asia.

Asia is the largest block of land on the face of the Globe; it is made even larger by having Europe, so to speak, soldered on to its western side; and it is dried in its central parts by their remoteness from oceanic winds. Africa, as well as Europe, makes a contribution to this effect. In spite of the set-back of the condition towards plant-growth, or rather because of it, the interior parts of Asia fostered the origin of the earliest system of agriculture which Nature pushed into the affairs of Man. Its emergence must not be attributed to a single determinant directing the lives of the prairie dwellers, for of determinants there were many leading towards versatility, and a large contribution came from the strong contrast between summer and winter.

Man, having long before abandoned arboreal habits, did not miss the trees and found the prairies a nursery in which to do some growing up. The conditions drew his food-gathering into the enterprise of hunting. The plants countered by early and abundant production of seed the hazards of their being killed out by drought. Man drew on the seed-harvest when it came, and on the tender buds of various plants when in new growth; for food at other times he depended on the mammals which he could catch. It is convenient to throw a line on a map round the area of his adventures; towards the west it encloses Egypt, towards the east it encloses the nearer part of India. The plains within the enclosing lines are all watered when the rivers are seasonally in flood. My reader remembers the Nile, the Euphrates, and the Tigris, and I remind him that the Indus must be added. The Fertile Crescent is made fertile by the silt of the first three rivers; the Indus plains are not quite as these, though of the same agricultural region. In its north-to-south dimensions, remotely in time, it must be allowed to enclose Inner Asia. Of a later time differentiation between a northern and a southern half by drawing a line along the Caucasus and along the rising land to the south of the Oxus becomes a descriptive convenience.

Within the enclosed area, undoubtedly before 10,000 B.C., Man domesticated the Dog to be a companion in the hunt. It had not been a particularly difficult thing to do. The Dog was accustomed to hunt in a pack, and when in the pack an urge to common action determined his behaviour. It was necessary to teach him as a puppy to consort with Man. He 'wolfed' his food when food was present, lest another should get it; but at all other times he would be co-operative. He shared Man's shelter and guarded it as his own, while the Man was doing what the Dog could not, planning the morrow and provisioning against it. Out of this planning came the domestication of Sheep. This and essays towards the domestication of larger animals dominated the prairie-man's life for millennia, not by reason of resistance from the domesticated but from the disciplining of Man himself. In a way the Sheep took possession of Man, who had to learn to devote the time which had been taken by the hunt to restraining, pasturing, and guarding his sheep. It is impossible to understand the slowness of the growth of culture without allocating a very long time to that phase. Time and time again Man relapsed individually and was driven back to hunting, then would renew the shepherding, until at last a whole-time shepherd resulted. The advantages of shepherding must for the area have been very great to recall Man to the occupation with millennial persistence.

Over those millennia the shepherd gathered such vegetable material as he needed and was available. His contemporaries who were without sheep did the same—year by year the varying flood of the rivers exposed for them bared mud; year by year they looked to the mud for the repetition of a certain source of food. It came naturally. It was the edible among the seedlings which appeared as the flood subsided.

We know that later in time there was a custom of using the Garden Cress, *Lepidium sativum*, in this manner. Its seedlings were pounded and crushed into a paste of the consistency of butter, and the preparation could be seasoned to fancy by the use of a considerable range of aromatic herbs, available to a food-gatherer. Though, at the period for which we have proof of the eating of such a preparation, the Cress must have been sown so long as seed was in hand, the food needed no cultivation whatsoever. I put it to my reader that, before there was any cultivation, such use of food-plants marked a period in Man's progress and that, though we have evidence of the collecting of edible seeds, we are not *ipso facto* in possession of evidence that particular seeds were obtained by cultivation. I prefer the term pre-cultivation for the process. The Nile floods in June and the water is warm and lasting; the Euphrates and Tigris flood earlier on the melting of the snows, and the water starts cold and the flood does not last long. The encouragement to scatter seed on the mud as the flood passes away would seem greater on the Nile than on the other rivers; but it would exist everywhere at all times in the making of what Woolley, in reference to the cutting of an irrigation channel at Ur, called 'garden plots' (see his THE SUMERIANS, p. 133, 1928). With only the tools available before metal came, Man could not be deterred from pre-cultivation.

The shepherd who drove his flocks into the mountains where the disappearing snows exposed new grass had his flooding rills and bared soil also. He, with the ability to keep sheep, inevitably had a wish to have vegetable food-supplies in hand; and we must credit him and his fellow men who were not shepherds with the ability to produce some handfuls of grain to scatter over exposed mud without tilling.

3. BARLEY AND WHEAT AT THE BEGINNING OF RECORDED HISTORY

Among the produce of the shepherd's pasture were certain grasses, attractive to the food-gatherer as producing the largest grass seeds of the pasture, seeds so large that they could be picked up readily between the finger and thumb and moreover growing in spikes by the culling of which they could be garnered with some rapidity. They were the seeds of Barley and Wheat. They were excellent as food and moreover welcome for providing beer.

I stress the importance of the second use for this reason: the provision for beer used up less than that for eating; and when returning after harvest-time from the pastures, with grain stored to transport the shepherd would be tempted to convey the lesser amounts he wanted for beer rather than the larger amounts needed for food. This ended in the driving of the interest in garnering Barley and Wheat into two tracks: (1) that of a static individual who made beer and allotted land for the receipt of seed, and (2) that of the shepherd who took his supply as found food. The beer maker naturally lived where his market was, that is to say in the growing population along the margins of the rivers that flooded. Food production was here entangled with beer production and enforced by the community headed by a king whose communal granary had to be kept filled and was. By the history of the riverside cities we get the date 4000 B.C. for the reaching of this phase in the Barley and Wheat agricultural system of the Fertile Crescent. The history of the entry of the Metal Age confirms the date. Tillage had by now a firm acceptance, copper and bronze being used for the agricultural tools where wood was not adequate, and the need of extending the spread of the flood waters by dug channels was great.

The 17th chapter of C. E. P. Brooks's CLIMATE THROUGH THE AGES begins: 'it is not many years since it was generally believed that variations in climate came to an end with the Quaternary Ice Age', and continues with data towards an understanding of variations in the Near East before and after the year 4000 B.C. From 5000 B.C. the humidity grew, then fell; but was still high at 4000 B.C., so that the establishment of tilling got encouragement when particularly wanting it. Climate and the coming of copper got into double harness; but after the harnessing the climate went on getting drier and less favourable. But counteracting and much more than counteracting the worsening, iron was brought into use. The Hittites, apparently an association of more than one origin, settled between Syria and ore-rich Cappadocia, discovered how to smelt iron. This was not far from

3000 B.C. up to which time the metal though known was not understood. The Pharoah ruling Egypt, Rameses III, heard of the Hittites' success and asked for a supply; he received a dagger and a promise of more iron when supplies had been built up. The fact that a weapon was sent exposes the purpose—war—for which the metal was asked. This coming of iron led greatly to the improvement of agricultural tools. A thousand years later, the Aryans, who would seem to have been not without affiliation to the stem of the Hittites, carried an iron-dominated animal husbandry through the hills of northern Persia into the plains of north-western India, where they broke into the eastward extension of the agriculture that the dwellers towards the west of the Fertile Crescent had built up on Barley and Wheat. The intervening millennium, it seems, had sufficed for a considerable building up in Sumeria; and this had been added to by contributions from beyond the southern end of the Red Sea, travelling by the Sabaean Lane towards India. The system reached forward then to the similar climate of the plains of the equally flooding Indus. It is time to seek light on it.

The two cities of these plains, Mohenjo-daro and Harappa, were riverside cities like those of the Fertile Crescent; the first was on the Indus itself, at about 125 miles from the sea, and thence drew a good deal of food in the form of cat-fish which would be sun-dried as modern supplies are. The circumstance indicates shipping on the sea. The second city was on the Ravi far above where it empties its waters into the Indus and about 600 miles from a coast. Both cities clearly had a well-occupied countryside to grow their food and timber; for the upper parts of the houses were wooden and the lower of burned brick which must have required fuel for burning. Harappa could have received timber floated down the Ravi, Mohenjo-daro by looking for it on the Takht-i-Suleiman. Bullock carts were so familiar as to vouch for earth roads. The basic grains were barley and wheat (emmer). Letters were not in use, but pictographic seals. Customs would seem to have been such as the Sumerian city of Ur had and friendships to have been in that direction. A clay tablet found at Ur names the cargo of a ship inward bound, the venture of a temple in Ur, that by its direction and by the copper ore in its cargo could have been returning from the coast of Mohenjo-daro.

At 2000 B.C. the prosperity of the Indus cities was sapped by some unrecorded agency. As the Aryans are thought to have arrived from 1700 B.C. onward, the agent would appear to have been another. It could have been by methods such as Nebuchadnezzar applied to the Jews—a removal of the leading men into exile. If so, then a condition which I should like to be able to show clear of agricultural stagnation would have been there when the Aryans thrust the prongs of their animal husbandry into the Sumerian tilling of the area. At any rate the agricultural Barley and Wheat system would survive at subsistence level. The Aryans claimed lordship, backed it by the power of their horsed chariots of war and their iron weapons; and their priests held the clan together by a claim to keeping contact with tribal gods by a liturgy which they kept rigidly precise as well as secret. If that worked, as it would seem it did in 1700 B.C., at 700 B.C. or approaching it the precision was failing, and Buddhism and the religion of the Jains came in a spirit of Reformation. And the concession of committing to writing a large part of the faith, an alphabet having been accepted from Persia at about 700 B.C., was for the counter of schism. Great changes were being made. And I want my reader to note in particular that, while they were being made, Rice arrived at that part of India in which the changes were being made. I take my reader across India to the further side of the Bay of Bengal in order to seek the manner in which the agricultural system of Aroids with Rice came about.

4. RICE IN INDIA

As a preliminary I need to state that we deal with not one species of plant, *Oryza sativa*, but with two kinds of cultivation: (1) by irrigation, and (2) without irrigation, or what is misleadingly spoken of as dry land rice. It was the first kind which alone was able to reach north-western India; the second would not be able to do so.

Oryza is a small genus, but occurs in three areas or regions of the Globe; the largest and appearing to be the oldest extends through eastern Asia and Malaysia and reaches Australia, the second and third are in tropical Africa and tropical South America respectively. All the species have in common three requirements which delimit the range: the first is tropical heat, the second abundant rain, and the third full or almost full sunlight; and these for the more important species must be continuous for a period of 6 to 8 months. Botanists are agreed that the cultivated Rice plant, which is *Oryza sativa*, originated in Asia and therefore in the humid south-eastern part, for there the three requirements could be met though far from widely. The wide deltaic areas, of which three are these: Ganges and Brahmaputra, Irrawaddi and Salween, Menam, Mekong, Hanoi, and Yang-tze-kiang, at sight offer possibilities and one or several probabilities. The sea face of these deltas is held by mangroves; it is towards the back that savannahs appear where trees are discouraged; and it is there only that light is added to heat and water in adequate supply.

The best studied of these deltas is that of the combined Ganges and Brahmaputra. It has two species of *Oryza* in it, *O. sativa* and *O. coarctata.* The latter is peculiarly restricted in distribution in India; in the Gangetic delta it is the commonest grass, showing a great suitability to its deltaic habitat, and in it the greatest prevalence is towards the back where the water reaching it is least saline. There it appears directly a bared surface is available over the band of islands covered by a dense growth of the sedges, *Cladium riparium, Scirpus grossus, Cyperus exaltatus,* and the grasses, *Phragmites karka, Andropogon intermedius, Imperata arundinacea,* and *Saccharum spontaneum,* capable of growing so densely and to a man's height, or enough for suppressing the *Oryza* although it does itself at times get to the same height. Widely it grows to no more than a few inches, salinity showing itself very inimical. My data are from Prain's paper on 'The flora of the Sundribuns' (*Rec. Bot. Survey Ind.* **2**, pp. 231-376; 1903). Of *O. sativa* in the delta, Prain remarks that 'it occurs everywhere . . . from the northern boundary to the sea-face . . . appearing as if feral after escape'. As to individuals he calls it rare, and it is difficult to use the information as an argument for the origin of cultivated rice. But as to the cultivation, it is distinctly suggestive of the habitat in which wild *O. sativa* appeared and from which it must have been taken by Man for providing food.

As in the origin of the Barley and Wheat system, the System now to be discussed began with animal food; but the food came from fish. The delta needed to be large, so large as to confine the Fisherman's living space to the flat land. Deep in it he had his shelter and he gathered such vegetable food as he wanted to eat along with the fish. I suggest that a beginning was made with perennial aroids which the Fisherman stuck into the bare mud banks of a creek conveniently near his shelter, and that into this perennial source of food in the course of time wild *Oryza sativa* was taken. The position suggested embanking and with that conditions were present for starting artificial lakes outside the delta, and the flooding inflow into the delta ceased to be a limiting factor. The parental wheats had fruiting spikes that shattered, so would, it seems, parental Rice have panicles which shattered. We find them characteristic of *O. sativa* var. *fatua* and take it for parental. But then it would seem that parent and selected cultigen entered India together. Man would try to eliminate, even unconsciously, the shattering. Giving the cultigen water, by which he enabled it to cross, he was imposed on by the parent, which crossed too.

The attraction of Rice, which sent its cultivation eastward, sent its cultivation southward into increasingly rainy country, where Man, to give it the needed sunlight, had to fell, for it was dry-land rice which was then raised. In as much as the labour of felling was more exacting than the labour of embanking, the date of the spread of dry-land rice to Malaya would be later than the commencement of the march of irrigated rice across India. Dry-land rice makes a return so much lower than irrigated rice that enterprise, where the labour of entrenching and terracing brought a reward, led to such glorious stretches of rice as may be seen in Java. They were developed late in time by redirection. Such Rice growing for success requires co-operative labour and has been a great political factor.

Irrigated rice in Java presumedly had no direct connection with the aroids that led irrigated rice to its popularity.

When did the cultivation of Rice reach north-western India? The Hymns of the Rigveda contain no mention of the grain. The Atharvaveda, which came as the last of the Vedas and other Brahmana literature and is dated by scholars as likely to have got into writing after 600 B.C., does. If it can be connected with the provision of spades, it perhaps started the journey from the head of the Bay of Bengal about 3000 B.C. The pace at first would be very slow; it would be slow again at the dry end of its journey by which time shipping leaving India at rice harvest would familiarize the grain at new ports without familiarizing cultivation. Campbell Thompson wrote in his DICTIONARY OF ASSYRIAN BOTANY (p. 106; 1949): 'there is no difficulty in accepting the certainty that rice was at least known, even if not cultivated, in Mesopotamia in the 7th Century B.C.' Laufer points out in his SINO-IRANICA (p. 372; 1919) that rice was unacceptable—we may say still unacceptable—in Persia at the date of Alexander the Great (327 to 325 B.C.). This would be natural, as the novelty of the cultivation would hold up the cultivators and the novelty of the domestic preparation would influence the markets. It was not until the 8th Century A.D. that Rice took first place in Persia. But it seems to have advanced rather more freely into Turkestan.

What of its passage across peninsular India? It had most certainly other cultivated plants in company. It is possible to name some; but to arrange their adoption chronologically is not possible

There was the Barley and Wheat system to the west of India and influencing the Indus plains at 3000 B.C., and this date has been suggested for the start of the movement of Rice from the Bay of Bengal. A subsequent leap of Wheat into the hills of the centre of India would be certain, and could take place early and be followed rapidly by acceptance for parallel cultivation of the three panics, *Panicum crus-galli, P. miliaceum,* and *P. miliare,* and in addition to *Paspalum scrobiculatum,* all four likely to have had their first cultivation in India. Probably the leguminous *Phaseolus radiatus* and two derivatives, *P. aureus* and *P. mungo*, were added, and *Amorphophallus campanulatus* as a root crop. Not one of these needed more water than the climate supplied within the Peninsula. If the acceptance of these was in India, they were most certainly associated with other cultivated plants before a date at which Rice took the local lead.

As moving with Rice from East to West were cultivated races of *Musa,* of *Dioscorea alata,* perhaps *Colocasia esculentum.* The conclusion is that Dravidian India collected to itself an agriculture between 3000 B.C. and the holding up of the Aryans' coming that was not despicable. Further than that, the closing of the gap between Rice and Wheat which brought all India everywhere a supply of the best available cereals was a tremendous event. The abundance favoured the release for agricultural labour that the Buddhist fraternity claimed and got, and it can be thought that the brilliance of the Gupta Period was not without stimulus from the resulting proportion between productivity and population.

5. BOTANY IN EUROPE DURING THE RENAISSANCE AND LATER

It is time to return to the botanists themselves to let the circumstance be explained of Europe possessing a system of Botany when the rest of the World had scarcely more than Botany's technologies. Firstly, the system had not at A.D. 1500 had time for spreading. To account for its origination by date and place is a more involved matter, involved because it had needed a very favourable working together of conditions to bring it about. The date had depended on the Renaissance of Learning which followed Europe's Dark Ages. Dr. Arber conveniently cuts out of the general renaissance a late part as the Botanical renaissance.

It is right to call it a movement—a movement among the physicians for accuracy in the healing herbs that they used; and for communicating their determinations to each other calling their books herbals.

They profited immensely by the development of printing among them; it gave them cohesion. Though they were of several nations the use of Latin secured a common understanding. When the North Italian physician Matthioli visited Vienna to verify if possible what Dioscorides used from the precious manuscript CODEX ANICIAE JULIANAE, his decision must have had rapid diffusion. The unification of the gathered knowledge was a great asset throughout the movement. It is interesting how woodcuts of plants reappeared in the works of others than the writer for whom they had been cut; but the publishers were instrumental there. A greater factor in the movement than the geographical unity was that the physicians were students of a limited flora, a flora which was in contrast to the exuberance of the tropical regions. I think that it is right to suggest that the system could not have developed without the joint cooperation of the three factors—the fraternity, the printing, and the restricted flora of a temperate climate. The like conjunction was improbable on two occasions in the World's history, and the initiated inevitably contacted new conditions wherever they spread. All of us in our education learn on simpler problems how to deal with the more complex ; and the initiated out of their experience were the more ready to read the problems of the Tropics when faced with them.

Let us straighten out the time-scale by a few dates.

In May 1498 a Portuguese ship, at the end of a voyage of 11 months, dropped anchor at Calicut. The voyagers stayed for nearly 6 months and then the first contact was over, with an exchange of merchandise and the departure of the Portuguese with such information as had happened to reach them. Other Portuguese followed. As I mentioned in my first chapter among them came Garcia da Orta, an excellent pharmacologist who spent the last half of his life in India and wrote a very worthy book on drugs. It held some botanical observations as well. Just in time to print it a printing press was set up in Goa and Garcia took advantage of it. The book, however, was for his fellow countrymen in Europe; it was intended to be read there. While as yet Garcia was alive, the missionary Christobal Acosta arrived in Goa where he met Garcia; his visit over he took to Burgos in Spain the materials for another book that holds illustrations of the plants that had interested him. He, better than Garcia, illustrates what I wish the reader to note, namely that the Portuguese had commenced sending botanical information to Europe. I am dividing the centuries from 1500 to 1900 into two parts by the fact that through the first part all the information gathered in India by Portuguese and also by those who followed the Portuguese was sent to Europe—each individual was looking back to the sources of his knowledge.

The Dutch were quick in the wake of the Portuguese and far more effective in carrying information to Europe, for their return voyage took them to the very hub of an interest in Indian botany which had arisen. The Dutch were better schoolmen, more receptive and open-minded, more organized; and one of them, Charles de l'Escluse (Carolus Clusius), as the result of visiting Spain brought to his countrymen the knowledge that Spain and Portugal had of the flora of the East. The Dutch interest grew; it may be said to have reached a peak in the time when Rheede was their governor of Malabar. London was also interested, and England produced the great patient naturalist, John Ray, whose HISTORIA PLANTARUM was an attempt at ordering the knowledge that had by then (1704) been collected. The size of Ray's great volumes testifies to it having outgrown classification.

Release came through Linnaeus, who was born two years after Ray's death. Linnaeus has been called the last botanist of the period of Herbals (Sachs), but as regards Indian Botany he was the first of a new period—an expansionist period, for which Linnaeus was fount and origin.

The collectors of plants went into the accessible parts of the World. It was the time when Captain Cook voyaged and when his and other's ships carried naturalists mainly for the purpose of collecting. India was accessible and not disregarded. India's pace of gathering knowledge was immediately increased by the work of men who collected for themselves more than for despatch to someone who had asked for specimens.

Linnaeus went through his probationary period with the limited flora of Scandinavia about him. With consummate skill he marshalled in his mind all that had then been written, without the blurring of the riot of the Tropics, and when he was ready he went to what I have called the hub, namely the Netherlands. From Holland he issued one after another what may be called a guide to the Botany of the time in five separate publications, which took the rank of text-books—his CLASSES PLANTARUM, GENERA PLANTARUM, BIBLIOTHECA BOTANICA, SYSTEMA BOTANICA, and FUNDAMENTA BOTANICA. Later he put forward an artificial system of classification for the purpose of methodically keeping in order records and herbaria. Though the sweeping away of the system began at once Linnaeus is, nevertheless, to be thanked for it as a setting of the house in order. There was no Darwinian theory then ascribing natural relationships, but only rather uneasy feelings that such would have to be given a recognition. Linnaeus's artificial classification was so simple that it eased the first botanizings of tyros and that is why it was so immensely beneficial for a while. Indian botany perhaps owes more in proportion to the number of botanists who appeared in India than most parts of the World, for India had such a considerable proportion of tyros. These were they who, with but an elementary knowledge, thrown into isolation in India turned to the plants around them for a kind of companionship in their leisure. Crawford has written of them in his HISTORY OF THE INDIA MEDICAL SERVICE, expressing the weight of their monotony and the need of relief. The direct cause of their arrival in India with an elementary knowledge was the way in which Botany had become popular in Britain among the more educated. The Linnean classification was that given to these.

Incidentally, it may be recalled that a pupil of Linnaeus reached India and brought his enthusiasm with him. This was Johann Gerhard Koenig (1728-1785).

6. SUMMARY

An analysis of the botanists of my second period begins here. I have found cause to mention no fewer than 457 persons as connected with my subject, and I have sought to classify them by the occupation which brought them to India, on which their occupation was changed, as for instance Benjamin Heyne who arrived as a missionary but was employed as a botanist, accepting that in which each was longest. The results are interesting, and perhaps unexpected. Out of the 457 for the second period 111 were either administrative officers or officers of the Army, and 104 were surgeons almost all at one time of the Army. The two added together amount to 3 in every 5. This is a large proportion and it is surprising not to find the surgeons outnumbering the others as elementary Botany had been in their curriculum. Perhaps we may say that the opportunities for botanizing after the officers had reached India had not been discriminatingly unequal. The East India Company never engaged an officer as a Botanist. After it had passed away some appointments were made of professed botanists. Again, out of the 457 one in eight visited India as travellers and the same as horticultural collectors; their purposes dictated the length of their stay.

These are some of the more prominent of the administrators or army officers: Beddome, Champion, Cathcart, Colebrooke, Drummond, Edgeworth, Hardwicke, Hay, Jenkins, Law, Madden, Poinwill, Sykes, Tanner; and these are among the surgeons: Alcock, Aitchison, Thomas Anderson, Barclay, Sir George Birdwood, Buchanan-Hamilton, Giles, Griffith, Sir George King, McClelland, Sir David Prain, Royle, Scully, Stocks, Stewart, Thomas Thomson, Wight, Wallich. It is interesting that the sum of the surgeons is only just larger than the sum of the other groups, for that shows, or rather suggests, that a proportion had taken to medicine through an interest in Natural History; and the earlier love came out.

It is seen that the University of Edinburgh played a great part in providing the surgeons. Therefore, it interests us who the Professors were. John Hope (1725-1786) was a man of ardour who embraced and taught the botany of Linnaeus. Robert Graham (1786-1845) drove into his pupils a recognition of the parts by which he classified plants, and was therefore the teacher of how to collect for the purpose of classification. John Hutton Balfour (1808-1884) got nearer to the living plant than his predecessors and gave to the many who received his teaching ecological ideas—these were very elementary; had they been more advanced, it had been easier to staff the Forest Service.

When the individuals are gathered together and rearranged by their botanical work, the general impression is that the surgeons did the most for the advancement of the subject.

(*Concluded*)

The Genus *Phoenix* Linn. in India[1]

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(With two maps and eight plates)

INTRODUCTION

Palms form a large family of tropical and sub-tropical woody plants not well studied taxonomically or anatomically. They belong to nearly 130 genera and 1100 species, but systematists like Lawrence (1951) believe that the number of valid species may be 4000 or more. As a rule the family is very poorly represented in herbaria and an appreciable number of genera and species are undoubtedly still unknown to science.

The family dates as far back as the Triassic (Brown, 1956) but it becomes prominent in many lands in the Tertiary period and continues to be so till the present time. It is concentrated in the Indo-Malayan region in the East, and in the tropical islands of the West. Its northerly limit lies below 40°N. latitude in the Mediterranean region, Afghanistan, and the Sino-Japanese region, and its extreme southerly limit is 44°S. latitude in New Zealand. Despite its large size very little work has been done on different aspects of the family, perhaps owing to the scarcity of authentic material and the technical difficulties involved in handling it.

Most of the taxonomical works on the family are old, there being no recent monographs. The present taxonomical accounts, therefore, are based on the works of Griffith (1850), Bentham & Hooker (1862-83), Wendland (1879), Drude (1887), Hooker (1894), and Beccari (1914, 1924). By far the best work on the taxonomy of palms in India is

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[1] This paper forms the seventh in a series of Studies on Palms, the earlier parts of which have been published as follows :

Part I. Notes on the anatomy of the peduncles in palms. 1950, *Proc. 37th Ind. Sci. Congr.* (Abstr.), part 3 : 52;

Part II. Anatomy of *Sabal palmatto.* 1953, *Proc.* 40*th Ind. Sci. Congr.* (Abstr.), part 3 : 101 ;

Part III. Anatomy of petioles in palms. 1953, ibid. : 102 ;

Part IV. ' Cytoanalysis '. 1953, ibid. : 102 ;

Part V. *Hyphaene indica* Becc.—I. Morphology (Part V). 1957, *Phytomorph.* 7 (2) : 185-194 ;

Part VI. Anatomy of palm roots. 1960, *Proc. Nat. Inst. Sci. Ind.* **26B** : 73-104. —EDS.

THE PALMS OF BRITISH INDIA AND CEYLON by Blatter (1926), describing both indigenous and cultivated species of India and Ceylon. The palms of the world, especially of the New World, have been monographed by McCurrach (1960), and Moore (1961) has revised their classification.

Economically, the family ranks next to grasses, the *tar-gur*[1] industry being one of the foremost cottage industries in parts of India. The State Governments are also taking active interest in introducing *Phoenix sylvestris* in arid regions where this *gur*-yielding palm thrives well.

As monocotyledons the palms are rather peculiar and present many archaic features. They are generally arborescent, some of them being branched, e.g. the genus *Hyphaene.* They have monocolpate pollen grains similar to those in the Cordaitales, Bennettitales, Cycadales, and Magnoliaceae. Their leaves have reins and hooks, the importance of which in the leaf morphology has been emphasized by Eames (1953).

Recently Mahabalé (1958) has stressed the importance of utilizing the characters of vessel members in the Palmae to distinguish genera and species, and Tomlinson (1960) has traced the trends of specialization in young leaves of palm seedlings. It is hoped that all these studies will ultimately help, *inter alia,* in resolving the fossil palms lumped together under the form genus *Palmoxylon.*

Prompted by these considerations studies on palms both living and fossil have been made in this Department for the past several years and the present paper is the seventh contribution in the series. It deals with the taxonomy, morphology, and geographical distribution of the species belonging to the genus *Phoenix* as they occur in India.

MORPHOLOGY

The genus *Phoenix* consists of tall trees or low shrubs, some of which are almost stemless. The stem is topped by a crown of leaves, those outside being in various stages of drooping. Those in the centre are younger and they form the bulk of the crown. The leaves are pinnate. The induplicate pinnae are entire, linear, longitudinally folded, and obliquely attached to the petiole by their folded base. The lowest pinnae are usually transformed into spines as in *Cycas.* There is no true midrib, but only a prominent nerve on the other side of the fold. The spadices are several, inter-foliar, erect when young. When fruited they become pendulous and are completely protected by coriaceous basal spathes. They bear either male or female flowers. The nature of the pinnae is of considerable importance in the classification of palms. In *Phoenix* they are induplicate, and Moore (1961) has utilized this character in separating Phoeniceae from the genera belonging to the Sabaleae. Cooke (1907) on the other hand classified the genus *Phoenix* Linn. on the basis of its habit as adapted below :

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[1] The thick viscid residue left on boiling juice tapped from the palm (*tar*); it may be consumed in this form or be processed into sugar.—EDS.

A. Very tall palms with stem more than 33 metres high ..	*Phoenix dactylifera* L.
B. Tall palms with stem 5-16 metres high :	
(i) stem slender, 10-16 metres high, leaves 2-4 metres long ..	*Phoenix sylvestris* Roxb.
(ii) stem stout, 5-6 metres high, leaves 1-1.5 metres long ..	*Phoenix robusta* Hook.
C. Low palms with very short stems, often stemless :	
(i) stem very short or nil ..	*Phoenix acaulis* Buch.-Ham.
(ii) stem 0.5-3 metres high ..	*Phoenix humilis* Royle

It is rather interesting to find that this rough and readymade classification derives further support from the external characters of stem as can be seen from Plates IV-VI figs. 16-22, and their analysis given below:

A. Stem surface very rough with persistent leaf bases :	
(*a*) ascending ..	*Phoenix sylvestris* Roxb. (Plate V, fig. 17) *Phoenix zeylanica* Trim. *Phoenix dactylifera* L.
(*b*) horizontal ..	*Phoenix roebelinii* And. (Plate V, fig. 18)
B. Stem surface semi-rough, without distinct annulate rings ..	*Phoenix rupicola* And. (Plate V, fig. 20)
C. Stem surface rough with annulate appearance and vertical cracks ..	*Phoenix reclinata* Jacq. (Plate VI, fig. 21)
D. Stem surface smooth and slender, with annulate rings ..	*Phoenix paludosa* Roxb. (Plate VI, fig. 22)
E. Stem surface semi-smooth, tessellated, looking more or less like a *Cycas* trunk ..	*Phoenix robusta* Hook. (Plate V, fig. 19)
F. Stem short or often rhizomatous with large, closely-set leaf bases ..	*Phoenix acaulis* Buch.-Ham. (Plate IV, fig. 16)

DESCRIPTION OF SPECIES

A. *Wild species*

1. **Phoenix sylvestris** Roxb.

(Plates I, fig. 1; IV, figs. 13-15; V, fig. 17; VI, figs. 23-24)

This is the commonest species of the genus in India and is quite abundant. It is a tall, graceful palm often called ' Wild Date '. It is about 8-16 m. high when not cut for tapping (Plate I, fig. 1). The trunk is rough owing to persistent leaf bases (Plate V, fig. 17). The crown is very large and thick, made up of 3-5 m. long leaves with compressed petioles. They have a few short spines at the base, triangular, 7-8 cm. long. Leaflets are numerous and end in short points. Male and female spadices are separate, 0.75-1 m. long, borne on different plants, on highly compressed, smooth peduncles. In a season 20-25 peduncles appear on a tree in the midst of leaves. Male spathe is coriaceous, separating into two boat-shaped valves. Numerous slender spikes emerge from the apex of the peduncle in fascicles 10-12 cm. long. Flowers are very numerous, white, about 6 mm. long, angular, and oblique. Cup-shaped calyx has 3 short rounded teeth. Petals concave three times longer than sepals, deeply furrowed and ridged on the inside. Filaments very short, free, anthers linear, adnate, shorter than petals. The female flowers are arranged in distinct groups on spikes 25 cm. long. The lower spikes are 8-10 cm. long and bear no flowers. Carpels are 3, free, erect. Ovules are solitary. Male flowers are roundish, their cup-shaped, 3-toothed calyx being very broad. Petals are convolutely imbricate ; and there are 3-4 staminodes.

Fruiting spadix about 1 m. long, fruits being confined to its upper $\frac{1}{3}$ part. Its lower $\frac{2}{3}$ part forms a handle, very much compressed. Many such spadices appear on a tree, and fruits are formed in huge bunches. Fruits 2.5-3 cm. long, oblong, ellipsoidal, orange-yellow in colour. Each fruit has a terminal stigma surrounded by perianth at the base.

Branching in palms on the whole is very rare, except in the genus *Hyphaene* Gaertn. where it is habitual. However, it does occur rarely in genera such as *Borassus* Linn., *Cocos* Linn., and *Phoenix* Linn. In Poona District itself four trees of *P. sylvestris* were found branching. Generally there are two branches, rarely more,[1] near the apical region of the tree or near the upper one-third of it (Plate IV, fig. 13-15). An intensive search showed that generally a few trees of *Phoenix sylvestris* Roxb. do branch. *P. dactylifera* L., which is occasionally bulbiferous, also branches but this is rare. A more thorough investigation on the branching and bulbil-forming habits in palms is desirable.

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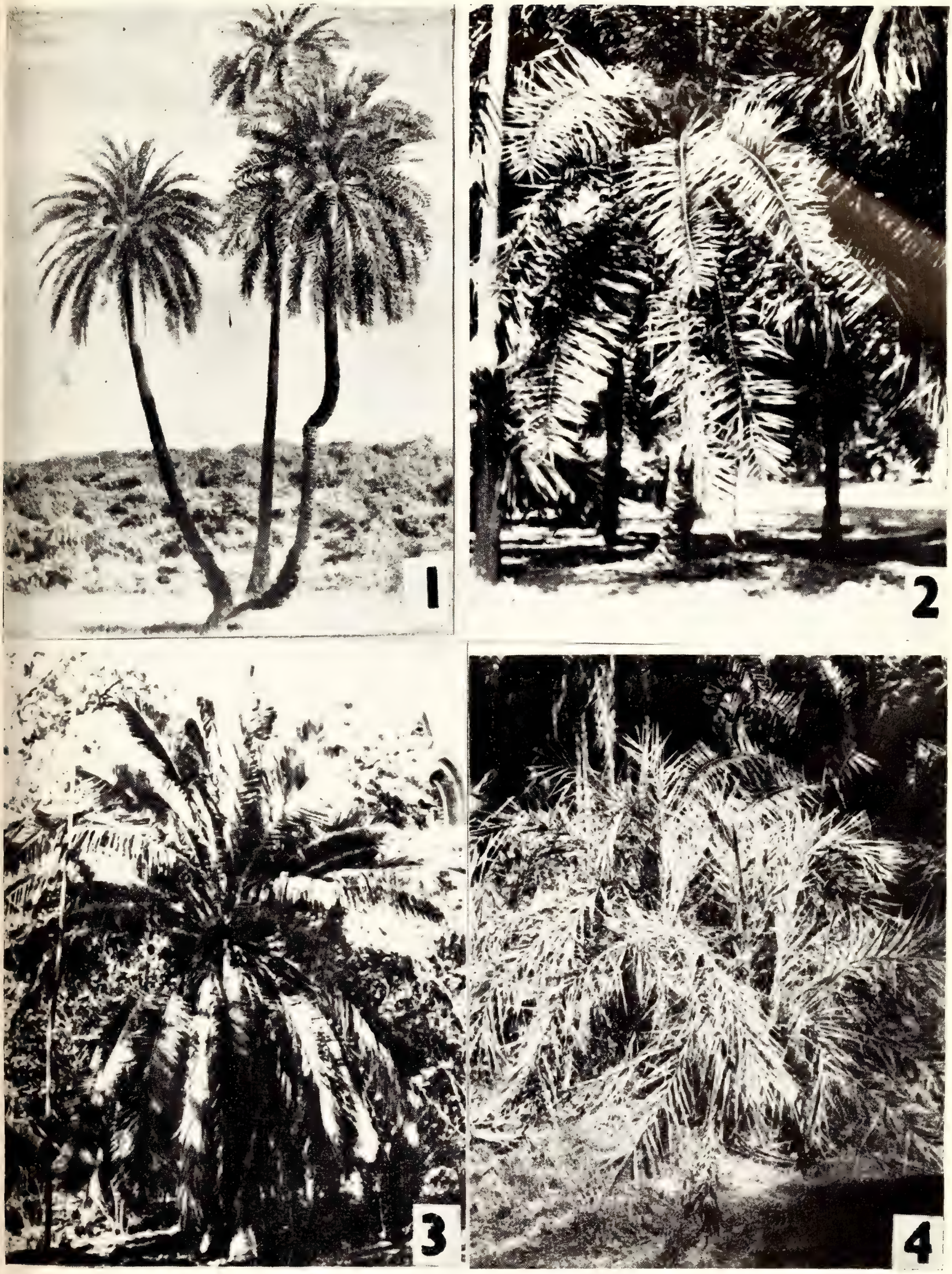
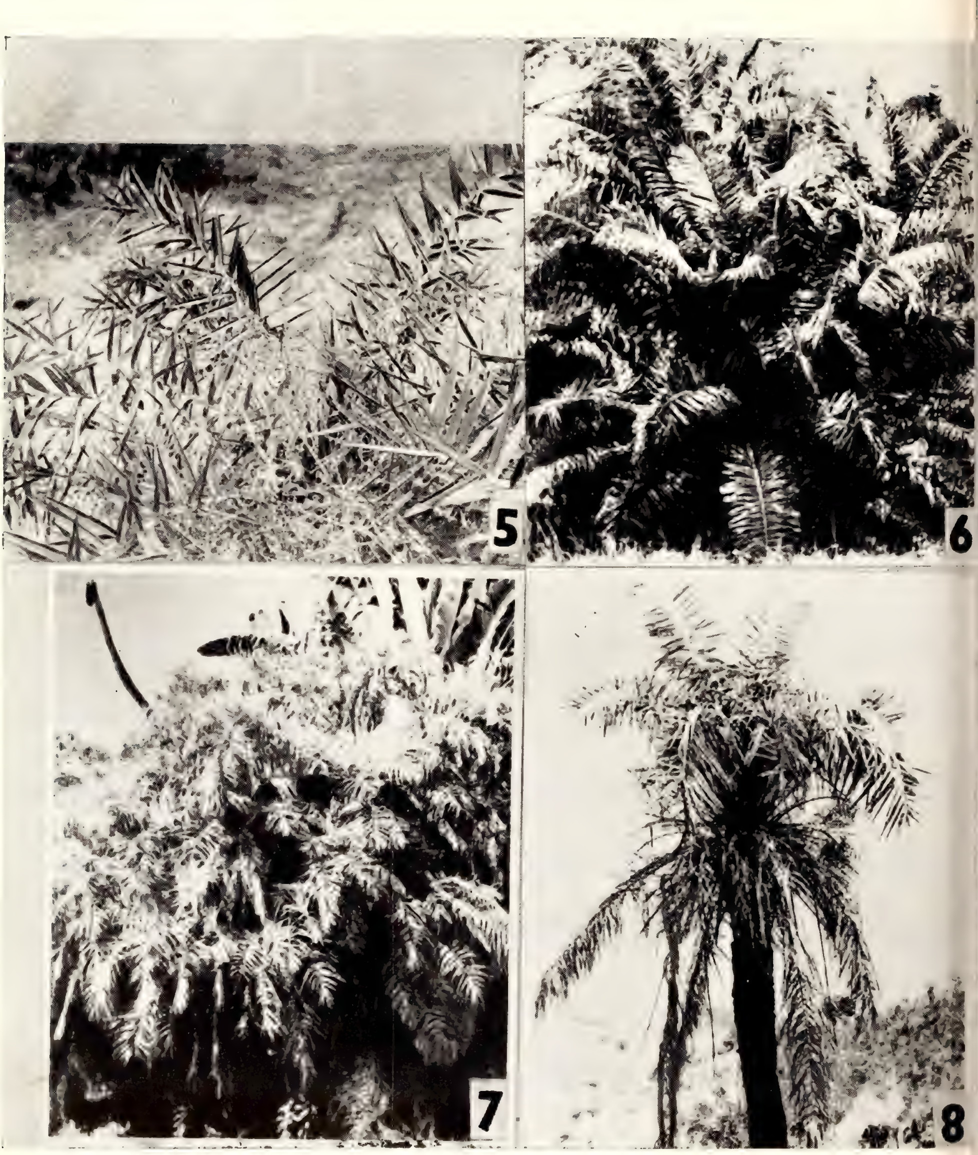
[1] For an instance of a 14-branched specimen see the *Journal*, 1908, **18** : 699-700. The branching in that case was attributed to the tree having been struck by lightning.—EDS.



The Genus *Phoenix* in India

1. *P. sylvestris* Roxb. (growing wild) ; 2. *P. zeylanica* Trim.; 3. *P. rupicola* And. ; 4. *P. acaulis* Buch.-Ham (growing wild in Mysore hills)

PLATE II



The Genus *Phœnix* in India

5. *P. pusilla* Gaertn. (growing wild near sandy coast at Pondicherry); 6. *P. humilis* Royle var *pedunculata* Beccari; 7. *P. paludosa* Roxb. (growing wild at Calcutta); 8. *P. robusta* Hook. f (growing wild at Bhorkas, Poona District)

Habitat. Most common throughout India, wild, or cultivated. It is abundant in Bengal, Bihar, the Coromandel coast, and Gujarat. In Maharashtra it is common throughout dry districts along the river banks, monsoon streams, and watercourses with subsoil water. It is thus a good indicator of moist substratum in dry areas. It grows in the plains as well as on hills up to 1600 m. in Kumaon, Garhwal, Jammu, etc.

2. **Phoenix zeylanica** Trim.

(Plate I, fig. 2)

This palm, known as the Ceylon Date Palm, resembles *Phoenix sylvestris* but differs from it in the habit of its leaflets. The stem is 3-7 m. high, rough, short, with very many quadrifariously inserted leaflets spread at right angles to the axis of the rachis. It is easily distinguished from *Phoenix sylvestris* by this character of its leaflets. Leaflets 20-25 cm. long, linear, lanceolate, coriaceous, bright green.

Male spadix about 30 cm. or more. Male flowers 4-5 mm. long, stamens 6, anthers subsessile, linear. Female spadix with longer peduncle, 2-3 cm. broad, flattened ; branches 20-25 cm. long. Female flowers scattered, globose, 3 mm. in diameter. Calyx cup-shaped, petals orbicular.

Fruits 1.5 cm. long and 0.75 cm. in diameter, obovoid, oblong, and apiculate, scarlet when unripe, dark purple when fully ripened.

Habitat. This palm of Ceylon grows along coastal streams and has been successfully introduced in many Indian gardens, e.g. at Baroda in the University Botanical Garden.

3. **Phoenix rupicola** And.

(Plates I, fig. 3 ; V, fig. 20)

This is by far the most handsome species of the genus. The trunk, 5-7 m. high, is slender with diameter about 20 cm., solitary, naked, annulate, but less conspicuously so. Leaves 3 m. long, with leaflets about 0.5 m. long, bifarious, flaccid, bright green. Petiole compressed. Spadices elongated, compressed. Female spadix 1-1.25 m. long. Fruits 1.75 cm. long, oblong, and shining yellow.

This species is easily distinguished from the rest by its numerous bright green, decurved leaflets, all in one plane. Very small spines towards the base of the petiole form its distinguishing character.

Habitat. Generally grows in rocky regions of Sikkim in the Himalayas, and in Mishmi Hills of Assam at altitudes 135-460 m. Being highly ornamental, it is a favourite in many gardens of India particularly in north India, e.g. the National Botanical Gardens, Lucknow, have several groves of this palm.

4. **Phoenix acaulis** Buch.-Ham.

(Plates I, fig. 4; IV, fig. 16)

This species, known as the Dwarf Date Palm, is almost stemless; its bulbiferous stem, 15-25 cm. in diameter, is underground (Plate IV, fig. 16). It is densely clothed with leaf sheaths and bases of petioles above the ground. Leaves are 0.75 m. long, leaflets nearly opposite, 20-50 cm. long, stiff. Petioles 30 cm. long with spines 5-15 cm. long, compressed, pale yellow. Male flowers 6 mm. long, alternate, solitary, sessile and pale yellow. Calyx cupular, 3-toothed; petals 3, obliquely lanceolate, acute; stamens 6, filaments very short, anthers linear, as long as the petals. Female flowers alternate, solitary, sessile; calyx cup-shaped; petals 3, truncate, sub-rotund, fleshy, concave, smooth; carpels three, each single-ovuled; styles 3, small, short and recurved. Fruits 1.75-2 cm. long, oblong-ellipsoid, fleshy, smooth; orange-red when unripe and blue-black when ripe.

Habitat. This species grows on hills, slopes, and elevated plains of Kumaon, and in the Khasi Hills, and on the northern side of the Ganges in north India. In peninsular India it is very abundant in the hilly tracts of Mysore, the Nilgiris, and parts of Telangana (Andhra Pradesh).

5. **Phoenix pusilla** Gaertn.

(Plate II, fig. 5)

A short palm with stoloniferous stem enclothed in the leaf sheaths. It grows in clumps. Leaves pinnate; petiole with one or more pairs of spines. Leaflets are sub-opposite, much pointed, rigid, and smooth. Spathe axillary, 1-valved, convex outside. Male flowers with 3-toothed small calyx; petals 3, white, oblong. Female flowers with 3 orbicular petals with recurved style. Spadices 20-30 cm. long. Ripe fruits 1.5 cm. long, brown outside, and greyish white inside.

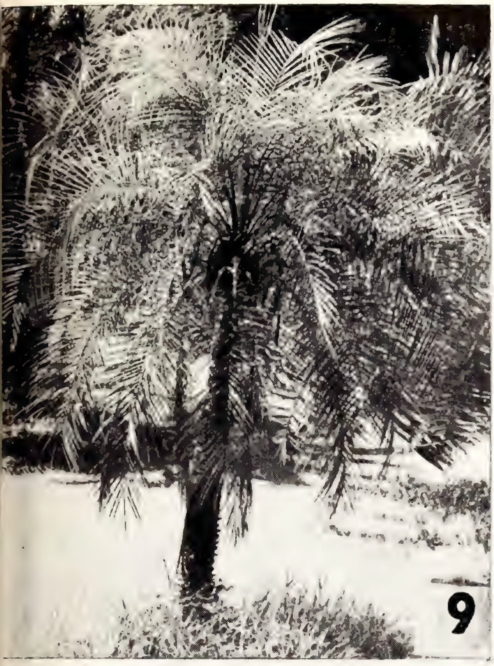
Blatter (1926) has followed Trimen (1893-1908) in considering this palm to be identical with *Phoenix farinifera* Roxb. Griffith (1850) has followed Roxburgh's (1874) description of *Phoenix farinifera*. Beccari (1877-1890) and Hooker (1894) have also named it as *Phoenix farinifera* Roxb. Blatter's choice seems to be more appropriate, and has been accepted here since his observations are more recent, direct, and agree with those of ours.

Habitat. Commonly found on the Coromandel coast, not far from the sea; seldom grown in parks and gardens.

6. **Phoenix humilis** Royle

(Plate II, fig. 6)

Stem short, tufted, rarely elongated. Leaves sub-glaucous, and leaflets interruptedly fascicled. Fruiting spadices long, fruits oblong, pericarp thin.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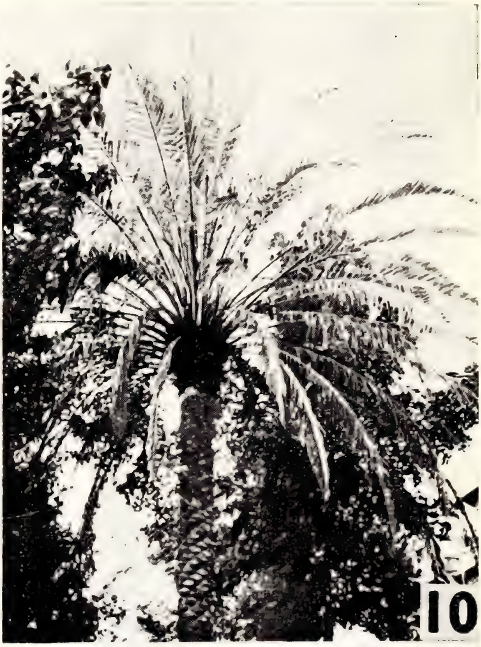
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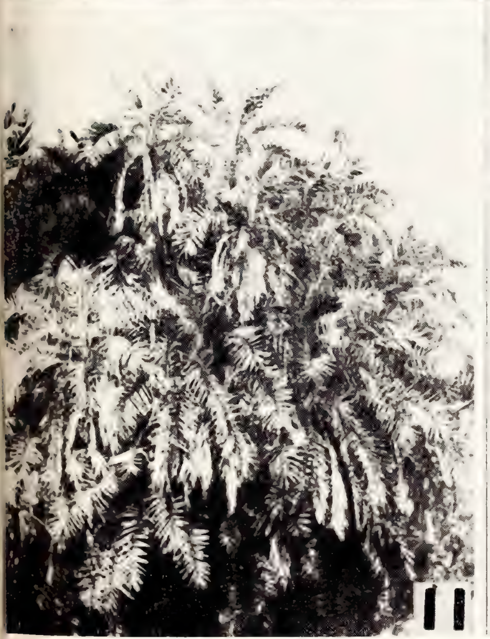
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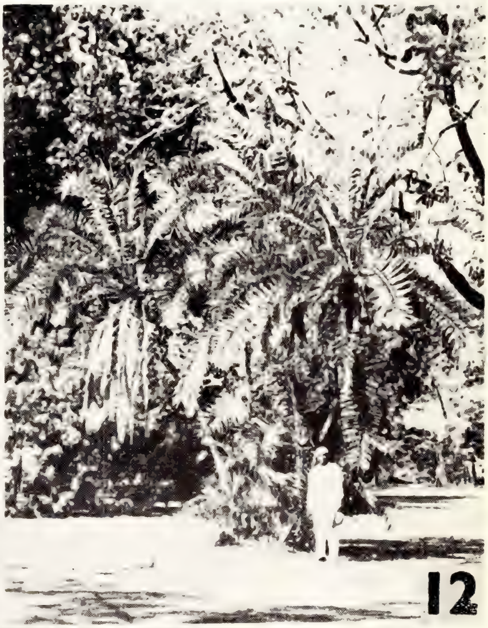
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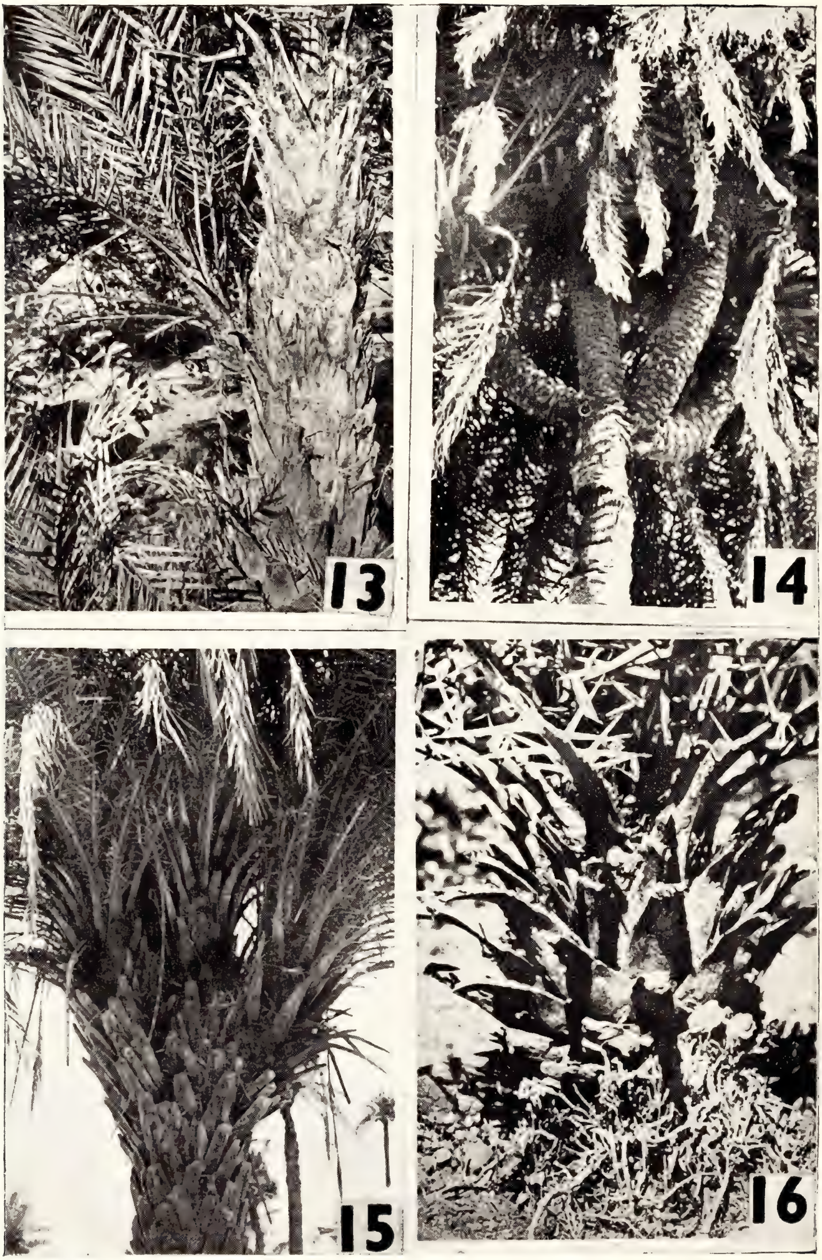
The Genus *Phoenix* in India

9. *P. roebelinii* O'Brien (growing in Maharajbag Gardens, Nagpur) ; 10. *P. dactylifera* L. ; 11. *P. reclinata* Jacq. (cultivated in Calcutta gardens) ; 12. gregarious bulbiferous *Phoenix* species (undetermined) (growing in Committee Gardens, Baroda)



Branching in *P. sylvestris,* and the stemless *Phoenix*, *P. acaulis*

13. *P. sylvestris* with side shoot growing from bulbil; 14. *P. sylvestris* with four branches; 15. *P. sylvestris* with three branches; 16. *P. acaulis* showing rhizomatous stem and large persistent leaf-bases

This species has three varieties : var. *loureirii*, var. *typica*, and var. *pedunculata*. The one collected and described here resembles closely var. *pedunculata*.

Phoenix humilis Royle var. *pedunculata* Becc. has stem 15 cm.-2 m. high, 20-25 cm. in diameter, densely covered with bases of fallen petioles. Leaves 1.5-2.5 m. long, pliable ; leaflets 25-50 cm. long ; petioles rather thin, about 3-5 cm. broad at the base, with spines often 6-7 cm. long. Spathes and spadix about 20 cm. long and with fringed margin. Fruiting spadices 1-1.5 m. long, compressed. Peduncle very much elongated, 1.25 m. long. Fruit orange in colour, turning black later.

Habitat. Found mainly in the Western Ghats from Konkan southwards, ascending up to 2000 m. in the Nilgiris and in hilly districts of Andhra Pradesh, Madras, etc. Very common in North Kanara Ghats at Castle Rock. Also grown in gardens.

7. **Phoenix paludosa** Roxb.

(Plates II, fig. 7 ; VI, fig. 22 ; VII, fig. 26)

This elegant palm grows like mangroves on coastal swamps (Plate VII, fig. 26). It is sub-arboreous, gregarious, with trunks 2.5-8 m. high, 7.5-10 cm. broad, soboliferous, annulate, except at the top (Plate VI, fig. 22). Leaves 2.5-3 m. long. Petiole brownish in colour at the base, often covered with scurf and triangular, channelled spines. Leaflets 0.25-0.50 m. long, opposite, alternate, bifarious, spreading, flaccid, with 8 distinct parallel veins. They have acuminate apex and are conduplicate at the base. Male and female spadices about 0.5 m. long. Male spathe compressed, coriaceous, and brown. Flowers about 6 mm. long, yellow. Petals 3, filaments 6. Female flowers greenish, petals round and concave ; staminodes 6. Fruiting spadix nearly 1-1.25 m. long, highly compressed and branched at the apex. Fruits 1.25 cm. long, sessile, placed on thickened knobs, yellowish in colour but turning red to purple on ripening.

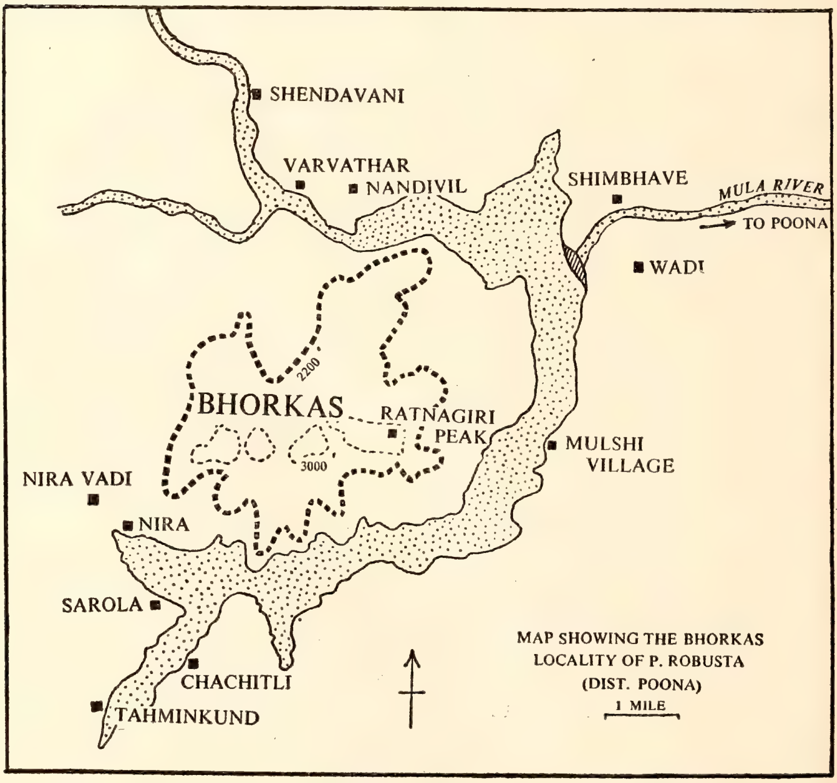
Hooker's (1894) description of *Phoenix paludosa* as having a stem 25-45 cm. in diameter seems to be slightly exaggerated. At any rate none of the specimens examined by us were larger than 22 cm. in diameter at the epi-basal region.

Habitat. A thorough study of the habitat was made during a tour to Andaman and Nicobar Islands. These palms grow along estuarine banks from the Bay of Bengal (Plate II, fig. 7) to Burma, and form a considerable portion of the littoral forests in the Sundarbuns (Bengal) and Andaman Islands (Plate VII, fig. 26). They grow luxuriantly in the central and southern Andamans and thrive very well near the sea-coast. They seem to tolerate and even to thrive better in places with a higher percentage of salt in the water, compared to *Nipa fruticans* which is also an estuarine palm but does better in water with a low percentage of salt. Thus though both *N. fruticans* and *P. paludosa* grow as mangroves in the same area, they do not do so in the same place or locality. Curiously *P. paludosa* is not so abundant on Nicobar Islands and is totally absent in Ceylon estuaries, although *Nipa fruticans* does occur in Ceylon. Apparently, though both stand similar climatic conditions, their edaphic requirements are different.

8. **Phoenix robusta** Hook.

(Plates II, fig. 8 ; VII, fig. 25)

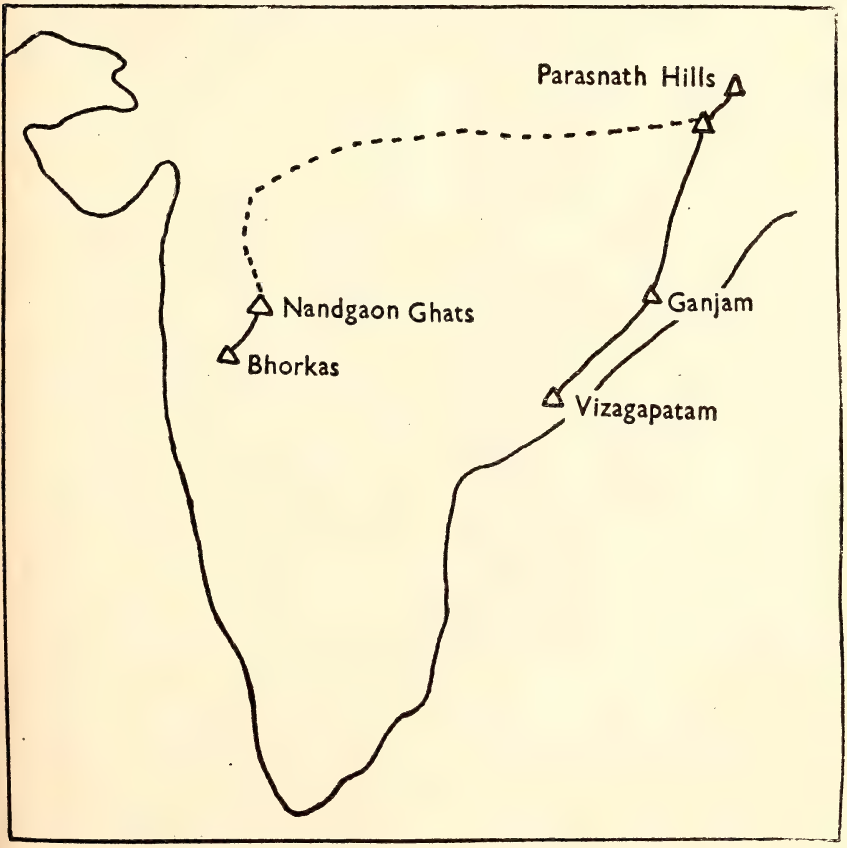
This interesting species was first described in detail by Woodrow (1899). Later Talbot (1902), Brandis (1906), and Blatter (1926) also described it following Woodrow's description. Earlier Hooker (1894) had collected this species from Parasnath Hill in Bihar. In the present investigation it was collected from a hill near the village of Bhorkas in Poona District (Maharashtra State), from where it was reported by Woodrow (1899) (see Map 1).


SHENDAVANI
VARVATHAR
NANDIVIL
SHIMBHAVE
MULA RIVER
TO POONA
WADI
2200
BHORKAS
RATNAGIRI
PEAK
3000
MULSHI
VILLAGE
NIRA VADI
NIRA
SAROLA
CHACHITLI
TAHMINKUND
MAP SHOWING THE BHORKAS
LOCALITY OF P. ROBUSTA
(DIST. POONA)
1 MILE

Map 1. The Bhorkas locality

The tree trunk about 5-6 m. high with diameter about 38 cm., looks tessellated (Plate V, fig. 19). Leaves 1-1.5 m. long, glabrous, shining, short, thinner and smoother than those of *Phoenix sylvestris.* Leaflets quadrifarious, strongly conduplicate. Fruiting peduncle 1.75 m. long. Ripe fruits brown in colour.

Blatter (1926, p. 24) had no material before him for complete diagnosis. Earlier description by Talbot (1902) is more detailed. Male flowers are alternate, solitary, 2-3 mm. long, pale yellow in colour ; calyx triangular, cup-shaped, truncate, and 3-toothed. Petals 3-4 times as long as calyx, ovate, concave, thick, smooth and longitudinally striated. Filaments very short. Fruiting peduncle 0.75-1.5 m. long, smooth, yellow, rounded and compressed by secondary axes, 15-20 cm. long. Fruit sessile, ovoid, cylindrical, 2 cm. long, 1 cm. broad, flattened and apiculate at the top ; smooth, fleshy and black when ripe. Talbot (1902) feels that this species may be a variety of *Phoenix humilis* Royle. Hooker (1894) also included this species under imperfectly known species. He, however, rightly pointed out that the tessellated appearance of the trunk is due to the comparatively small size of the adpressed old leaf sheaths



Map 2. Distribution of *Phoenix robusta* Hk. f. in India

on the trunk, on account of which it looks like *Cycas* stem. This character of this species is highly distinctive (Plate V, fig. 19).

Habitat. This species is confined to small isolated areas in the trap hills of western India, particularly to the Ghats in Poona and Nasik districts, to Parasnath Hill in Bihar, and to a few places in Andhra Pradesh such as Ventala in Vizagapatam and Ganjam District (Map 2). Owing to its gregarious nature in certain localities and occurrence in restricted areas, a detailed study of its habit was made near Bhorkas Hills, about 36 miles to the west of Poona. It was from this locality that Woodrow (1899) had described this species. Map 1 illustrates this area in which the species grows gregariously. The hill on which this species grows borders on the Mulshi Lake in Poona District. Here also it is more or less restricted to particular hillocks at altitudes about 600 m. and is not very common. Only a few plants grow below 575 m. altitude. They are quite abundant between 675 m. (*c.* 2200 ft.) and 1000 m. (*c.* 3000 ft.) level (Plate V, fig. 19). These areas are demarcated by contour lines in the map. Possibly the gregarious habit of this palm and its occurrence at certain places only may be due to edaphic and historical factors rather than climatic, and hence its endemic nature. Its geographical distribution in India is discontinuous and is shown in Map 2.

9. **Phoenix roebelinii** O'Brien

(Plates III, fig. 9 ; V, fig. 18)

A dwarf species seldom growing more than 2 metres with stem 10-15 cm. in diameter. Leaf 0.25-0.5 m. in length, curving and drooping. Leaflets 15-20 cm. long, very narrow, numerous, and dark green. Peduncle about 30 cm. long with obovoid fruits about 1 cm. long. The fruits bright red in colour when unripe.

Blatter (1926) has included this species as a variety of *P. humilis* (var. *loureirii*). The morphological characters, however, do suggest that it may be raised to the level of a species.

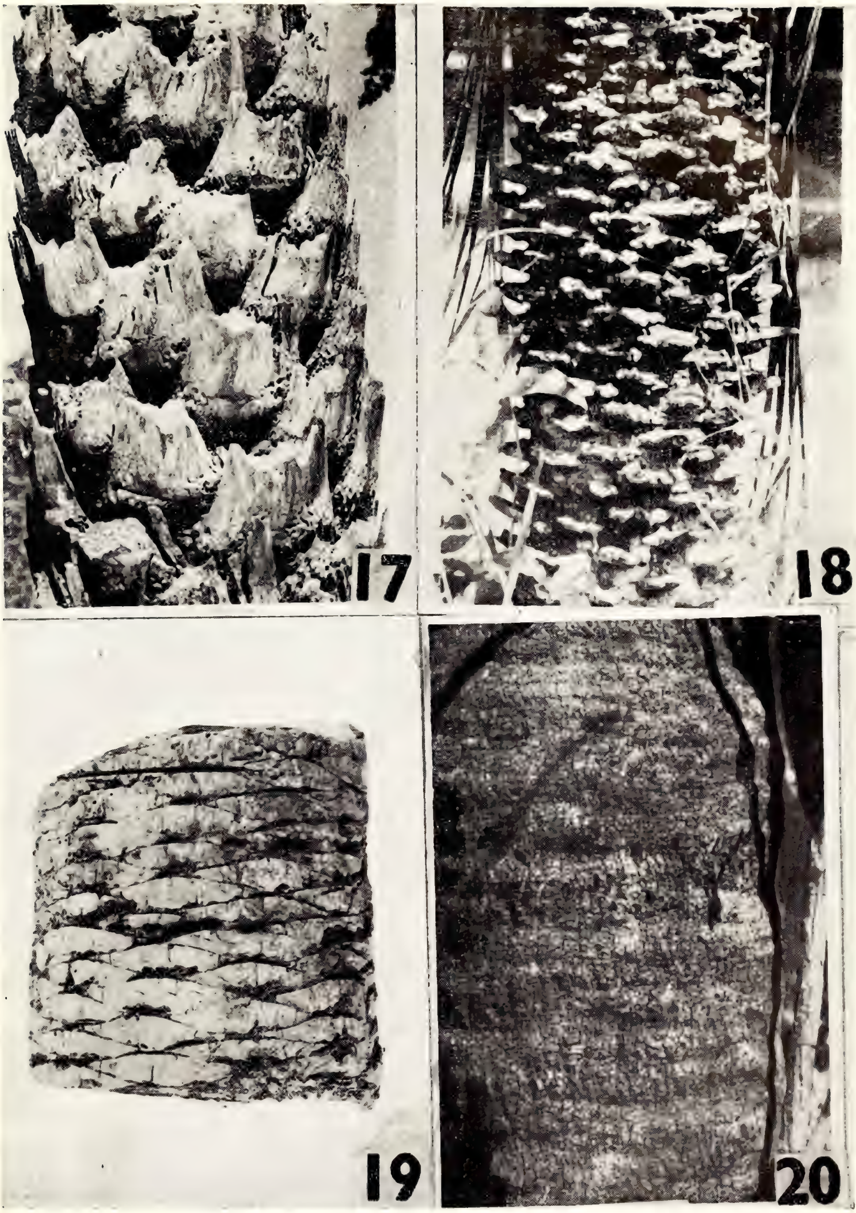
Habitat. Khasia Hills, Assam ; Burma. Also grown in a few Indian gardens, e.g. at Nagpur in the Maharajbag Gardens.

B. ***Introduced species***

10. **Phoenix dactylifera** Linn.

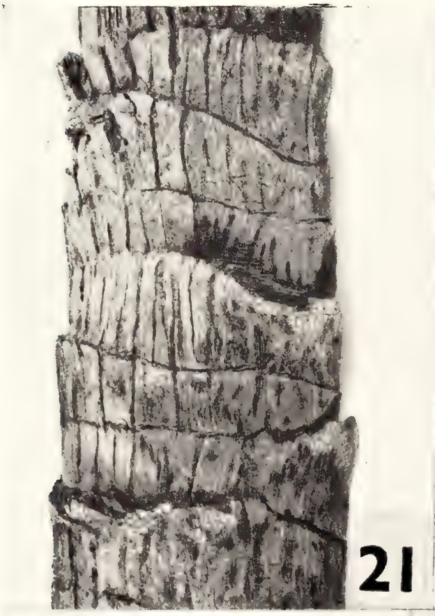
(Plate III, fig. 10)

A very tall palm often attaining a height of 33 m. or a little more introduced from the Middle East. The trunk is covered with persistent leaf bases similar to those in *P. sylvestris* but they are shorter. Its leaves are longer than those of *Phoenix sylvestris*. They do not droop as in the latter, but stand straight and pointed, rather obliquely in the crown of leaves ; this gives it a characteristic appearance (Plate III,



Stem in *Phoenix* species

17. *P. sylvestris* with persistent leaf-bases; 18. *P. roebelinii* with horizontal persistent leaf-bases; 19. *P. robusta* with tessellated diamond-shaped leaf-scars; 20. *P. rupicola*—semi-rough stem having more or less annulated appearance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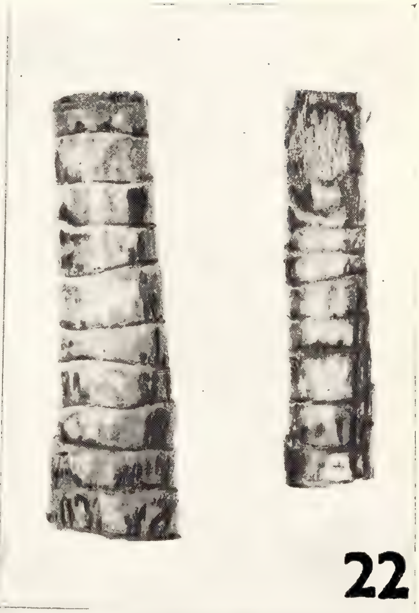
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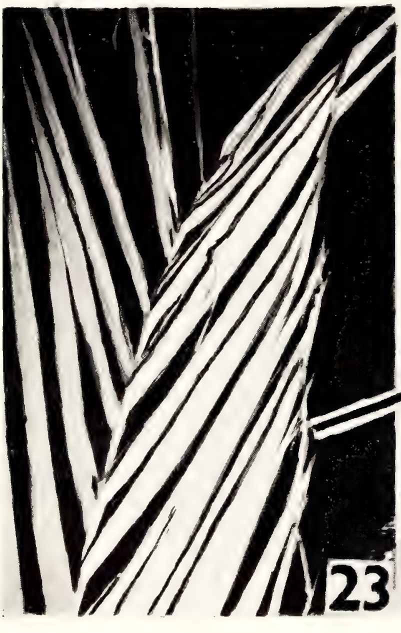

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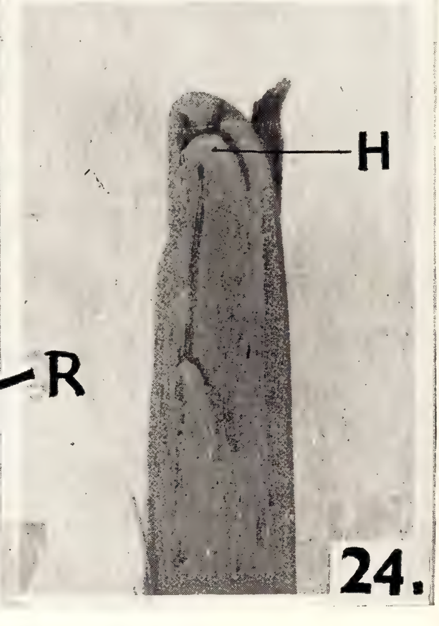


24.

Stem and young leaves in *Phoenix*

21. *P. reclinata*—stem distinctly annulate with vertical cracks; 22. *P. paludosa*—smooth stem with distinct annuli; 23. *P. sylvestris*—young leaf with reins (R); 24. The same, showing young leaf with hook (H)

fig. 10). Leaflets are 20-40 cm. long, regularly distichous, and form a very acute angle with the petiole. Petioles grey and flat at the base. Male peduncle short, flowers 5-6 mm. long, scented. Female spadices 0.5-0.75 m. long. Fruit oblong, 2.5-6 cm. long, reddish brown in colour.

Habitat. This species has the highest commercial value in the whole genus. It is cultivated on account of its fruit, and has many varieties. It is self-sown in Sind and southern Punjab, and is also cultivated in the Sindhu-Sagar Doab in the trans-Indus territory. It is occasionally cultivated in drier and sandy regions of northern Gujarat, e.g. around Surendranagar or at Mt. Abu, but is grown quite often in parks and gardens. Its cultivation in other parts of India is worth trying. It is largely propagated by man, its fruit being a favourite dessert.

11. **Phoenix reclinata** Jacq.

(Plates III, fig. 11; VI, fig. 21)

This palm is introduced from Africa. Its soboliferous stem is 6-10 m. high, at times more. Its leaves are long and armed with solitary or basal spines on the lower surface. Leaflets are ensiform and numerous. Male flowers lanceolate, acuminate ; calyx 3-dentate, petals lanceolate. Female flowers arranged on 20-25 rigid secondary peduncles ; calyx 3-dentate, staminodes 6. Fruits oval, yellowish orange in colour ; seeds oblong with prominent longitudinal groove.

Habitat. Grown in some gardens in India, e.g. in Indian Botanical Gardens, Sibpur, Calcutta. It is found throughout tropical Africa.

12. **Phoenix canariensis** Hort.

A tall palm with solitary stem, often reaching 15-18 metres high and covered with persistent leaf bases. The species can be easily identified by its exceedingly large crown of leaves consisting of 175-200 leaves and short straight cylindrical massive trunk. Leaves 6-7 metres long, stiff. Leaflets about 150-200, long, pointed, induplicate, light green. Inflorescence including peduncle often 2 metres long. Male flowers alternate, angular ; calyx cup-shaped, trigonous, sharply 3-dentate ; petals densely striate. Stamens shorter than petals. Female flowers globose, depressed ; calyx cupulate, 3-ribbed, acutely dentate ; petals twice as broad as long. Fruit ovate or sub-globose, produced in heavy clusters, 2 cm. long, orange-coloured.

Habitat. Canary Islands. Grown in some Indian gardens, e.g. at Allahabad, Agra, and Delhi. A great favourite in gardens in Latin countries bordering Mediterranean Sea ; also in Georgia, U.S.S.R.

General Considerations

A. *Habitat and Distribution*

The paper gives an account of nine species of *Phoenix* indigenous to India and three introduced ones. Of these *P. pusilla* needs further study and clarification. The broad morphological features of these species and their geographical distribution are given. Among the species described *P. robusta* is endemic, *P. paludosa* grows like mangrove, *P. acaulis* is montane confined to hilly regions of north and south India, *P. pusilla* inhabits the dry regions near the Coromandel coast, and *P. sylvestris* is cosmopolitan occurring both in the hills and on the plains of India.

In point of fruit, *P. dactylifera* is the most important, but is not much cultivated. The possibility of introducing it as a horticultural crop in suitable arid regions, as has been done in California, needs immediate exploration. It is likely to succeed in the coastal regions of western India, especially in the drier parts of Konkan, northern Gujarat, Rajasthan, Vidarbha, Telangana, and Anantapur District.

From the *tar-gur* industry's point of view, *P. sylvestris* is equally important. The utility of other species for making *gur* or *nira* is not yet studied. This also should be considered important as the Vitamin C content of *tar-gur* obtained from *P. sylvestris* is quite high. About this and other aspects of *P. sylvestris* and other species of *Phoenix* available in India, we know next to nothing.

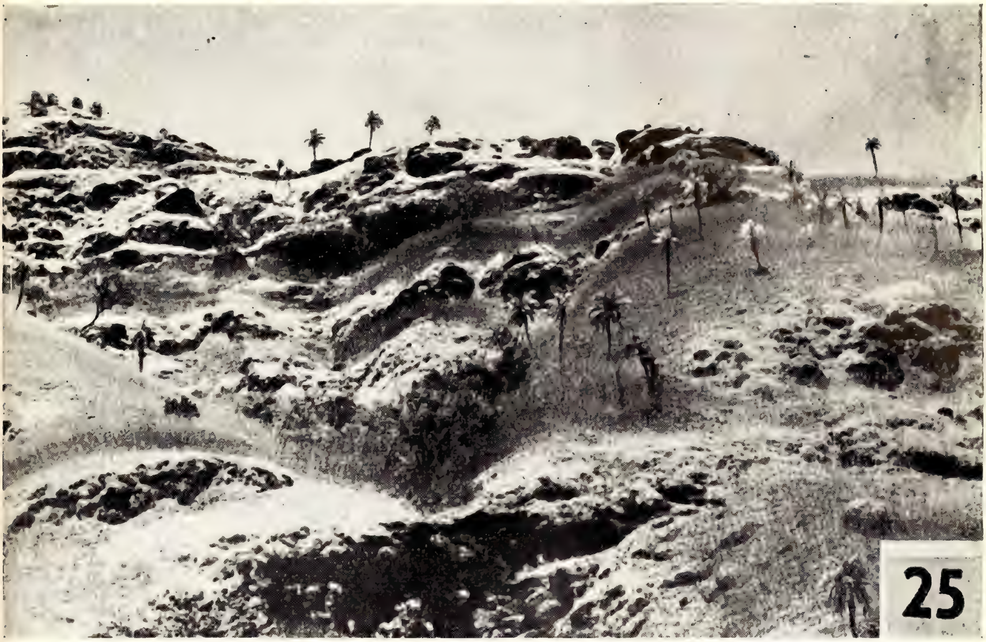
B. *Morphological*

Morphological observations assume great importance in palms, as it is not always possible to collect flowers, fruits, and other parts in order to determine the systematic position of a particular palm or its species. These, therefore, are briefly discussed below.

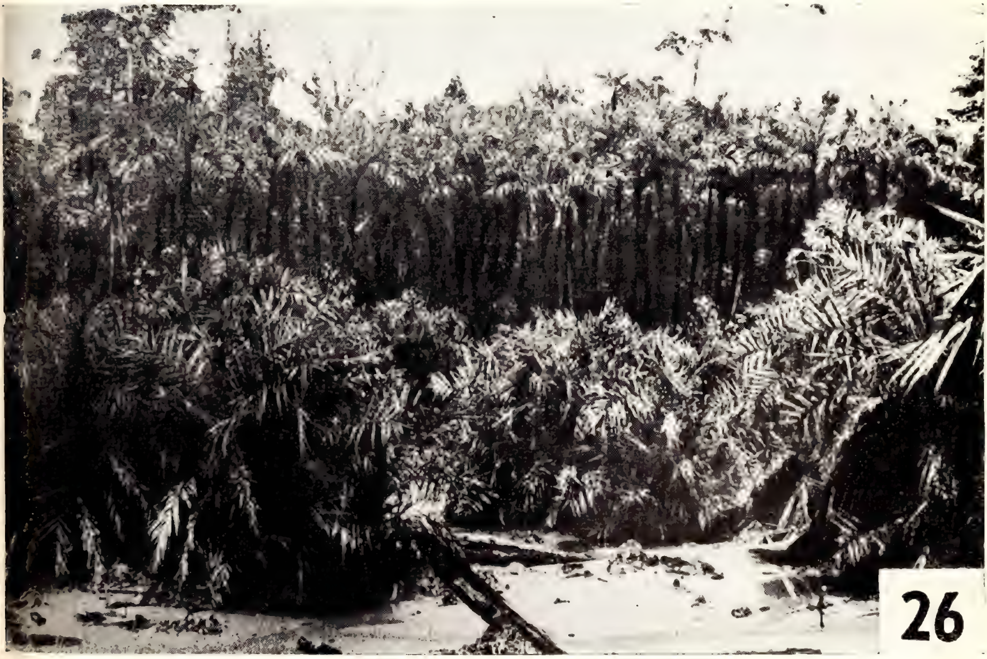
Phoenix is the only genus in the Tribe Coryphineae which has pinnate induplicate leaves looking V-shaped in vertical section. The leaves in different species, however, do not show much difference in their broad features and hence the main characteristics of the genus *Phoenix* are :

i. *Basal spines on the leaf.* These are uni-, bi-, or quadrifarious and project laterally from the rachis at various angles. A regular transition of spines into leaflets is noticeable in *P. sylvestris*, *P. acaulis*, etc. (Plate VIII, figs. 1-4).

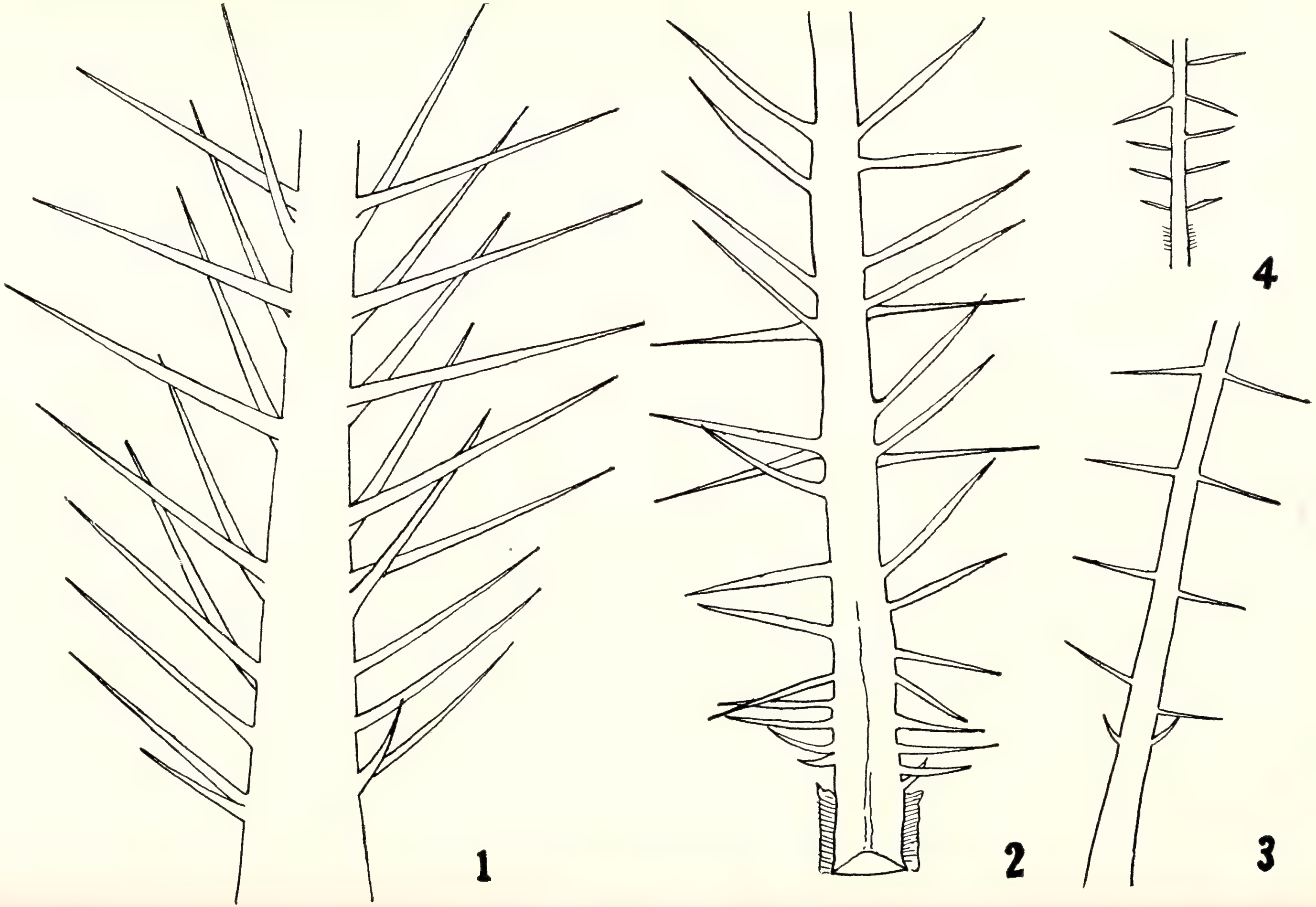
Secondly, though both in *Phoenix* and *Cycas* lower leaflets are converted into spines, their mode of formation is quite different. In *Cycas* the primordium of each leaflet or spine is separately laid ; in *Phoenix* phyllopodium as a whole is formed and then as the reins get disintegrated, leaflets and spines are separated from each other schizogenously.



25. *P. robusta* growing wild on low hills at Bhorkas (Dist. Poona)



26. *P. paludosa* growing wild on coastal swamps in the Andaman Islands, forming thickets



Spines in *Phoenix* Linn. species

Fig. 1. *P. sylvestris* × ½; Fig. 2. *P. reclinata* × ½; Fig. 3. *P. acaulis* × 1; Fig.

In other words, no separate primordia for spines or leaflets are laid in the genus *Phoenix*.

ii. *Induplicate nature of leaflets.* This is a constant feature of all species of the genus, but the amount of folding undergone by the leaflets, their angle of attachment to the sides of the more or less trigonous petiole are different in different species. In *P. robusta* this angle is so small that a leaflet looks almost flat as in *Crysalidocarpus* except at the point of its attachment with the rachis, whereas it is so acute in *P. roebelinii* throughout the length of leaflet, that it looks urn-shaped.

The stem in *Phoenix* is rather variable. It cannot be depended on as a generic or broad character, as shown by Mahabalé (1958), nor does it fit in Von Möhl's (1849) classification of palms based on stem characters only. The leaflet characters, on the other hand, such as size, arrangement of pinnae on the rachis (petiole), their projection laterally, and the angles of the laminar fold about mid-vein, do help in identifying species. Table below gives a summary of leaf and leaflet characters in the species studied.

iii. *Reins and hooks.* Arber (1922) and Eames (1953) have already drawn attention to these neglected structures in the morphology of palm leaf. Eames (1953) is of the opinion that the ' reins ' and ' hooks ' in an unfolding palm leaf are related to the evolutionary derivation of a compound leaf whether palmate or pinnate from a simple leaf. In this connection it is rather interesting to find that these ' reins ' were first observed in palms by Mirbel (1843) in the genus *Phoenix*, and later in other palms by Naumann (1887) etc. The ' reins ' of *Phoenix* definitely show reduction as compared to the rest of the genera of the Coryphineae. The reins in *P. sylvestris* are brown in colour, about 2-3 mm. wide. They are extremely fragile. The hook also is not prominent and in many cases is indistinguishable (Plate VI, fig. 23 and 24). These features no doubt show greater advance over that in *Corypha* where the ' reins ' are green, fleshy, ribbon-like and often persistent even after the leaf has been fully unfolded. The hook is also not very prominent in *Phoenix*. The ' reins ' in *Phoenix*, therefore, do not seem to be primitive but reduced ; hence, its leaf notwithstanding its pinnate nature like *Cycas* or fern leaf may not prove to be the most primitive type in palms.

Phoenix leaf shows further specialization in having the topmost leaflets turned into rigid hook-like structures. It appears that this helps in holding the ' reins ' in position till the leaf opens out fully, as the hook and ' reins ' in *Phoenix* are poorly developed.

iv. *Pinnate nature of the leaf.* This is by far the most important character of the leaf of this genus. The Phoeniceae are considered to be a primitive subfamily or tribe of the Palmae. This naturally raises

TABLE

LEAF AND LEAFLET CHARACTERS IN THE SPECIES OF *Phoenix* STUDIED

P. sylvestris	*P. zeylanica*	*P. rupicola*	*P. acaulis*	*P. pusilla*	*P. humilis* (var. *pedunculata*)
20-35 cm. long with sharp points ; dark grey, green ;	20-25 cm. long with sharp points ; bright green ;	45 cm. long, bifarious; bright green ;	25-40 cm. long, grey-green ;	20-30 cm. long, pale green ;	25-35 cm. long, green glaucous ;
inserted in several planes	coriaceous, quadrifariously inserted and spread at right angles to the axis of the rachis	flaccid, decurved, inserted in one plane	stiff ; nearly opposite	sub-opposite, rigid and smooth with sharp end ; quadrifariously inserted	no regular plane of insertion
P. paludosa	*P. robusta*	*P. roebelinii*	*P. dactylifera*	*P. reclinata*	*P. canariensis*
20-50 cm. long ; light green ;	20-35 cm. long ; green, glabrous ;	10-15 cm. long ; dark green ;	40 cm. long, grey-green ;	25-30 cm. long, green ;	20-30 cm. long ; light green ;
opposite to alternate ; spreading and flaccid ;	quadrifarious strongly conduplicate	very narrow, numerous, not stiff	stiff with sharp points forming very acute angles with the petiole ; have no regular plane of insertion	narrow, stiff, with sharp points	pointed, stiff
8 distinct parallel veins, conduplicate at the base					

the question whether its pinnate leaf is more primitive than the palmate leaf in other genera ; but this may be discussed later.

v. *Seedling leaves.* Eophylls in palms are important from the phylogenetic point of view and Tomlinson (1960, 1961) has emphasized their importance in determining the primitive or otherwise nature of leaf in palms. According to him eophylls are simple in *Phoenix* species. Observations made on the leaves of seedlings in *P. sylvestris*, *P. rupicola*, *P. paludosa*, *P. robusta*, and *P. dactylifera* showed that in these species simple lanceolate eophylls occur till they are above 2 cm. wide and 20 cm. long. Separation and formation of pinnae takes place later resulting in the imparipinnate leaf characteristic of the genus and induplicate pinnae attached to the rachis at various angles.

The leaf in *P. paludosa*, however, is a little exceptional in this respect. It was noticed that in this palm, growing abundantly in mangrove swamps in the Andamans, simple eophyll on the seedlings persisted for a much longer period than in other species. For example, it was common to find simple lanceolate eophylls in this species as long as 35 cm. and as broad as 3-5 cm., and still the pinnae were not cut. However, a detailed study of this feature in different species of *Phoenix* and of leaf forms intermediate between simple lanceolate leaf and pinnately cut leaves would be worth pursuing.

vi. *Inflorescence.* The inflorescence and the peduncle in *Phoenix* show vast difference from the rest of the genera falling under the subfamily Coryphineae. The flowers and fruits in *Phoenix* are crowded into a cluster on each flat peduncle, only towards the upper one-third part thereof, in contrast to other genera traditionally included in the tribe Sabaleae in which the flowers and fruits are borne along the entire length of the floral axis.

Further the flowers in Phoeniceae are dioecious and more evolved than the polygamous flowers in the rest of the genera of the Coryphineae as pointed out by Hutchinson (1934). Therefore the separation of the genus *Phoenix* by Moore (1961) seems to be justifiable, as also Hutchinson's (1934) classification of Palmae in which he has removed Phoeniceae from the Coryphineae and has placed it next to Cocoineae[1] as a distinct tribe.

C. *Species Incertae Sedis*

As early as 1894, Sir Joseph Hooker (1894) pointed out that the tentatively diagnosed species of *Phoenix* in India await much further knowledge from living plants before they can be accepted as trustworthy. The position with reference to certain Indian species still remains the same and hence the keys given to identify them should not be considered to be final or phylogenetic.

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[1] Hutchinson's classification of Palmae (1934) : (1) Corypheae ; (2) Borasseae ; (3) Lepidocaryeae ; (4) Calameae ; (5) Areceae ; (6) Cocoineae ; (7) Phoeniceae ; (8) Phytelephantineae.

Position as regards the taxonomy of African species of the genus is also equally uncertain as rightly remarked by Blatter (1926, p. 2), and attempts are being made to clarify it by studying their morphology, anatomy, and embryology. Plate III, fig. 12 illustrates a species growing in the Municipal Committee Garden at Baroda which has gregarious soboliferous stems and which defies analysis. Possibly it is an introduced species and belongs to the *P. paludosa-reclinata* group but is not *P. paludosa*. Similarly, the exact points of dissimilarities between *P. pusilla* and *P. acaulis* also need further investigation on all grounds, morphological, cytoembryological, and anatomical.

D. *Past History*

The genus is believed to be of much wider occurrence in the past. It is supposed to have originated in the Liassic period from which a leaf resembling *Phoenix* leaf called *Propalmophyllum liassimum* has been described by Lignier (1907). Another species resembling *P. robusta* anatomically has been found in the Deccan Intertrappean Series belonging to early Tertiary Period (see Mahabalé, 1958, p. 81). Several seeds of it are found in London Clay Flora. Its leaves from the Tertiaries of Europe have been described under the name *Phoenicites*. The genus, therefore, may prove to be quite ancient, but possibly multifocal in its origin. Today it is mostly concentrated in India, Ceylon, Middle East, and Africa.

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The Birds of Nepal

PART 10

BY

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[*Continued from Vol.* **60** (1) : 200]

Family ESTRILDIDAE

*719. **Estrilda amandava amandava** (Linnaeus). Indian Red Munia.

The Indian Red Munia is known from Nepal only through Hodgson's later collection (Horsfield & Moore, 1856, p. 502 ; Gray, 1863, p. 56 ; Sharpe, 1890, p. 322)[1].

*720. **Lonchura malabarica malabarica** (Linnaeus). Whitethroated Munia.

Loxia malabarica Linnaeus, 1758, Syst. Naturae, 10th ed., **1** : 75. (India, restricted to Malabar, Kerala, by Baker, 1921b, p. 725.)

The sole authentic record of the occurrence of the Whitethroated Munia in Nepal has been provided by Rand & Fleming (1957, p. 201) on the basis of two specimens taken in the eastern tarai in winter. There are, however, two specimens in the British Museum presented by Hodgson, but Sharpe (1890, p. 371) gave 'Behar' as their locality on unknown authority.

721. **Lonchura striata acuticauda** (Hodgson). Hodgson's Munia.

DUN : Hitaura : 1 ♂ (May 13).

Hodgson's Munia appeared rather rare in central Nepal, having been met by us only once at Hitaura, when a flock of about half-a-dozen birds was seen.

Scully (1879, p. 333) and Ripley (1950b, p. 413) found it only once each in the Nepal Valley, where Proud (1955, p. 66) noted it as a resident bird. Polunin (1955, p. 893) reported it from the Trisul Valley, central Nepal, in summer. Rand & Fleming (1957, p. 201) recorded it as common in western and west-central Nepal at *c.* 290-1220 m. in winter, but did not find it in central.

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[1] It has since been reported from Nepal by Fleming & Traylor (1961, *Fieldiana, Zool.*, **35** : 484). Additional information contained in this and other papers received after the present series started appearing in 1960, as well as in the valuable field notes very kindly made over to me by Col. F. M. Bailey will be utilized for a supplementary part of the series.

The specimen under report is very worn, and the crown and throat are moulting (see also Vaurie, 1949a, p. 36).

Measurements : 1 ♂ : Wing 52+ ; tail 43+ ; bill 12.

722. **Lonchura punctulata punctulata** (Linnaeus). Indian Spotted Munia.

BHABAR : Amlekhganj : 1 imm. ♀ (March 6). DUN : Hitaura : 2 ♂♂, 6 ♀♀ (June 13, 14, July 6). NEPAL Valley : Thankot : 1 imm. ♂ (March 30).

The Spotted Munia is common in the central dun, but we did not find it so elsewhere in central Nepal. It occurs in flocks in cultivated fields, especially those that are near forests.

Rand & Fleming (1957, p. 201) reported it also from western and west-central Nepal at *c.* 275-915 m. in winter.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	54, 56.5	43, 45	12, 12.5
6 ♀♀ :	54(2), 55, 56, 57(2)	40(2), 42, 44, 45,—	11.5, 12(4), 12.5

723. **Lonchura malacca rubroniger** (Hodgson). Chestnutbellied Munia.

DUN : Hitaura : 1 ♀ (July 1).

The Chestnutbellied Munia was found by us only once in central Nepal in a paddy field near Hitaura in a loose party of four or six individuals.

The only other post-Hodgsonian record of this munia from Nepal is Scully's (1879, p. 332) who noted it as common in the Nepal Valley from the end of May to October.

My specimen is very worn, and is marked ' laying ' on the label.

Measurements : 1 ♀ : Wing 56+ ; tail 35+ ; bill 12.

Family PLOCEIDAE

*724. **Passer domesticus indicus** Jardine & Selby. Indian House Sparrow.

This is the common House Sparrow of the lowlands of Nepal.

No specimen was taken by us.

725. **Passer domesticus parkini** Whistler. Kashmir House Sparrow.

NEPAL VALLEY : Kathmandu, Thankot: 9 ♂♂, 1 (♂), 8 ♀♀, 1 (♀) (March 21-April 28).

The Kashmir House Sparrow is common practically all over central Nepal from the dun upwards about human habitation. It is commoner in towns and larger villages than in the smaller ones. It is frequently found associated with the Tree Sparrow (*Passer montanus*) in mixed feeding flocks.

One of my female specimens (Thankot, March 31) is an abnormal intersex (= '*Passer enigmaticus*' Zarudny). This has already been commented upon by Vaurie (1949a, p. 16) and Mayr (1949, p. 305).

The birds had near breeding gonads in March and early April, but fully breeding from about the second week of April.

Colours of soft parts : Iris brown to grey-brown ; upper mandible pale horny to horny with darker tip ; lower mandible fleshy with dusky tip ; (bill black in male from about mid-April ; gape yellow in female and near breeding male) ; legs and feet pale horny brown ; claws horny ; pads white.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	75, 77, 79	55, 59, 62	14.5(2), 15
5 ♀♀ :	73, 73.5, 74(2), 76	52, 53(2), 56, 57	13, 13.5(2), 14, 14.5

Other male specimens measure (Vaurie, 1949a, p. 18) : 7 ♂♂ : Wing 75.5-81 (av. 78.4) ; bill 13-14.5 (av. 13.8).

Although the central Nepal examples of the species are included under *parkini*, it must be understood that they differ from topotypical examples by being somewhat paler in general coloration and in the chestnut of males, and by having a fulvous tinge on the underside of a few female specimens. They are, in fact, somewhat intermediate between *parkini* and *indicus*, but closer to the former.

*726. **Passer rutilans cinnamomeus** (Gould). Himalayan Cinnamon Tree Sparrow.

Since Hodgson's days, the Cinnamon Tree Sparrow has been recorded from Nepal only by Proud (1949, p. 711) in the Nepal Valley during April, and by Rand & Fleming (1957, p. 200) in the Kali Gandak Valley, west-central Nepal, at *c*. 760-1980 m. in winter.

*727. **Passer montanus tibetanus** Baker. Tibetan Tree Sparrow.

The first authentic record of the Tibetan Tree Sparrow from Nepal has been furnished by Rand & Fleming (1957, p. 200). They report its occurrence in the Kali Gandak Valley, west-central Nepal, at *c*. 2745 and 2805 m. in winter. Lowndes's (1955, p. 34) earlier record of the bird under *malaccensis* from Manangbhot, central Nepal, at *c*. 3960 m. in summer, refers in all probability to *tibetanus*.

728. **Passer montanus malaccensis** Dubois. Malayan Tree Sparrow.

Dun : Bhimphedi : 3 ♂♂, 1 ♀, 1 juv. ♀, 1 nestling in alcohol (March 11, 13, May 3, June 18, 19). Chitlang Valley : Chitlang : 1 ♂, 2 ♀♀ (March 15-18). Nepal Valley : Kathmandu, Thankot : 3 ♂♂, 2 ♀♀, 1 subad. ♀, 1 unsexed (March 23, April 8-25, June 29).

The Malayan Tree Sparrow is quite a common bird of central Nepal from the upper dun (Bhimphedi region) upwards, and in this zone it appears to be commoner than the House Sparrow (*Passer domesticus*).

Below Bhimphedi in the dun, however, it is not so common, and *P. domesticus* appears to be the commoner bird. Mixed feeding flocks of the two species are frequently observed in the Nepal Valley.

Rand & Fleming (1957, p. 199) have reported it also from west-central Nepal.

My May-June specimens are worn.

Three male specimens collected on April 10 and 12 were marked 'breeding', while a female taken June 29 was marked 'laying' on the labels.

The female specimen indicated as subadult above (Kathmandu, April 25) has the throat and central rectrices in moult. Ithas the forehead to nape rufous-brown with chestnut tinge above and behind the eyes, lores and under the eyes sooty, general coloration of plumage paler than that of adults, chin and throat dusky, remiges dark brown with rufous edges, no white tips to the greater wing coverts, and the rectrices brown with rufous edges. However, this specimen had granular ovary measuring 6 × 5 mm., suggesting that it was preparing to breed.

The juvenile female specimen (Bhimphedi, June 18) also has moulting central tail feathers. In coloration this specimen appears nearer adult than the subadult bird. Its upper plumage is darker than the subadult specimen but paler than the adult, forehead to middle of crown with a dusky tinge, remaining parts of the head almost as in adult, under parts and tail as in the subadult bird. This specimen, however, had quite undeveloped (non-breeding) ovary. From the evidence available, it is not possible to say with any degree of certainty whether breeding in this species normally takes place even before the birds attain full adult plumage.

Colours of soft parts : Iris dark brown (grey in juvenile) ; bill blackish in May and June, otherwise horny to dark horny with yellowish on base and gape ; legs and feet light fleshy brown (fleshy in juvenile) ; claws horny ; (fleshy in juvenile) ; pads pale yellow.

Measurements :

	Wing	Tail	Bill
7 ♂♂ :	70.5, 72(2), 72.5, 73(2), 73.5	47+, 53.5, 55, 55.5, 56(2), 56.5	12.5, 13(3), 13.5, 14(2)
5 ♀♀ :	67, 68, 69 (2), 69+	50+, 51, 52 (2),—	12.5, 13 (2), 13.5 (2)
1 unsexed :	71	56	13

729. **Petronia xanthocollis xanthocollis** (Burton). Yellowthroated Sparrow.

TARAI : Simra : 1 ♀ (March 5). BHABAR : Amlekhganj : 1 ♀ (March 6).

The Yellowthroated Sparrow was met with by us only a few times in the tarai and bhabar of central Nepal in small, loose parties on scrub and hedges bordering cultivation during early March.

The only other post-Hodgsonian record of this species from Nepal is Rand & Fleming's (1957, p. 201) from the central dun and eastern tarai.

Measurements: 2 ♀♀: Wing 77, 80; tail 52(2); bill 13, 13.5.

[**Montifringilla adamsi adamsi** Adams. Tibetan Snow Finch.

Most of the standard books on Indian avifauna include Nepal within the range of the Tibetan Snow Finch (Oates, 1890, p. 246; Hartert, 1910, p. 134; Baker, 1926, p. 187; Vaurie, 1959a, p. 589; Ripley, 1961, p. 598), and it very probably occurs there. However, I am unable to trace any definite record of any specimen of the species taken in that country.

Montifringilla blanfordi blanfordi Hume. Blanford's Snow Finch.

Although there is no definite record of the occurrence of Blanford's Snow Finch within the territories of Nepal, I am inclined to agree with Ripley (1961, p. 599) that it 'probably occurs in extreme northern Nepal'.]

*730. **Ploceus benghalensis** (Linnaeus). Blackthroated Weaver Bird.

Rand & Fleming's (1957, p. 202) collection from the western tarai in winter provides the lone post-Hodgsonian record of the Blackthroated Weaver Bird from Nepal.

731. **Ploceus philippinus philippinus** (Linnaeus). Indian Baya.

NEPAL VALLEY : Thankot 12 ♂♂, 2 ♀♀ (April 11, May 20, June 29, July 25).

More than eighty years ago, Scully (1879, p. 332) found the Baya a common bird in the Nepal Valley from mid-April to end of September. However, we could discover only two breeding colonies near Thankot. Ripley (1950b) did not find any, and Rand & Fleming (1957, p. 202) found it only occasionally in the western tarai in winter, but none in central Nepal.

The Thankot colonies were first noticed by us in the second week of April. The birds were then starting to build nests on a solitary large tree growing on the edge of a paddy field, and on a palm tree near by growing in a patch of fallow land overgrown with grass. About a month afterwards the nests were found to be from a quarter to a third complete, but on June 25 most of the nests were almost complete, a few being actually complete. On that date there were some 20 nests on the large tree, with a few very incomplete ones which were obviously abandoned at the early stages. The palm tree had 12 almost complete nests with four old, disarrayed ones.

Proud (1949, p. 710) has reported it as common in the Nepal Valley. She further noted that its breeding there is rather late, end May to end September. During that season, however, we had been in the Nepal Valley only for very short periods. This fact must be responsible for our failure to observe more breeding colonies there.

The male specimen taken April 11 is in eclipse plumage, but the May and June specimens are all in breeding dress. They had breeding gonads too. The July 25 female bird had already laid.

Colours of soft parts : Iris dark brown; bill in breeding male very dark horny, in others horny brown with yellow on base and underside of lower mandible ; legs and feet horny brown, paler in female ; claws light horny ; pads fleshy.

Measurements :

	12 ♂♂	2 ♀♀
Wing :	71, 73(2), 74,74.5, 75(4), 76,76.5, 77	71, 74
Tail :	47, 47+, 48, 49(3), 50(4), 51,—	48, 51
Bill :	18(2), 18.5(2), 19(5), 19.5(3)	18.5, 19

The central Nepal birds are somewhat intermediate between *philippinus* and *burmanicus*. The males have the yellow pectoral band broken and a little narrower than that of true *philippinus*, and the yellow on back is confined to a small area on the upper back only. They are, however, nearer the Indian subspecies. See also Vaurie (1949a, p. 33).

Family STURNIDAE

732. **Saroglossa spiloptera** (Vigors). Spottedwinged Stare.

BHABAR : Amlekhganj : 3 ♂♂, 2 ? imm. ♂♂, 2 ♀♀ (March 8, 9). DUN : Hitaura : 2 ♂♂, 1 imm. (fledgling) ♂, 1 ♀ (June 12-21, July 19).

The Spottedwinged Stare is occasionally seen in the bhabar and dun of central Nepal, in flocks (March) or in pairs (June-July). This appears to be the only record of the species from Nepal since Hodgson's time.

The March birds are in fairly fresh plumage, but the June birds are all worn.

The fledgling (July 19) has been described in detail by Marien (1950b, pp. 472-473). The two doubtfully immature male specimens are in feminine plumage, but are as large as fully adult males. Can they not be adult males in 'retarded' plumage (for discussion, see Marien, op. cit., p. 473) ?

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	110, 110+, 111(2)	57, 58, 58.5, 60	24.5(2),25,—
2 ? imm. ♂♂ :	109, 111	59,60	22.5, 24
3 ♀♀ :	105+, 105.5, 106	56(2), 57	22, 23(2)

Ticehurst (1935b, p. 870) and Marien (op. cit., p. 472) are of the opinion that *assamensis* Baker should not be recognized.

733. **Sturnus malabaricus malabaricus** (Gmelin). Greyheaded Myna.

TARAI : Simra : 2 ♂♂ (March 5). BHABAR : Amlekhganj : 1 ♂, 1 ♀ (March 6, 7). DUN : Hitaura : 10 ♂♂, 1 imm. ♂, 3 ♀♀ (May 16-June 16). NEPAL VALLEY : Pashupatinath, Maharajganj, Thankot : 4 ♂♂, 3 ♀♀ (April 11, 12, 28-May 5, 20).

The Greyheaded Myna is a common bird of central Nepal. It occurs in the Nepal Valley from about the first week of April onwards, but is resident in the lower regions.

Rand & Fleming (1957, p. 193) have recorded it from west-central Nepal at *c.* 915 and 1370 m. in December-January.

My March specimens are in fresh plumage. The April birds are slightly worn, and the May and June birds are more so.

Specimens taken during April and the single example of May 25, had near-breeding gonads which were fully developed in other May and early June birds.

Colours of soft parts : Iris bluish white (once creamy white and once greyish white); bill blue on the basal third, gradually changing to yellow on the anterior third, so that the middle third is light green, bluish proximally and yellowish distally ; legs and feet light yellowish brown ; claws light brownish horny (once light horny) ; pads white.

Measurements :

	Wing	Tail	Bill
7 ♂♂ :	99, 100(3), 102, 103.5, 105	60, 61, 62, 63(2), 64, 65	21(2), 22(2), 22.5, 23, 24
2 ♀♀ :	95.5, 99	59, 60	21.5, 22

*734. **Sturnus pagodarum** (Gmelin). Blackheaded, or Brahminy, Myna.

*735. **Sturnus roseus** (Linnaeus). Rosy Pastor or Rosecoloured Starling.

Hodgson's collection has provided the only records of the occurrences of the Brahminy Myna and the Rosy Pastor in Nepal.

*736. **Sturnus vulgaris poltaratskyi** Finsch. Finsch's Starling.

The record of Finsch's Starling from Nepal is based on one of Hodgson's specimens and Scully's (1879, p. 329) only specimen. The latter was taken from the central plains in winter. See also Sharpe (1890, p. 34).

*737. **Sturnus vulgaris porphyronotus** Sharpe. Central Asian Starling.

The only authentic record of the occurrence of the Central Asian Starling in Nepal has been furnished by Rand & Fleming's (1957, p. 193) collection from the western tarai in winter.

*738. **Sturnus vulgaris humei** Brooks [1]. Himalayan Starling.

The only record of the Himalayan Starling from Nepal is based on Hodgson's collection (Sharpe, 1890, p. 36).

*739. **Sturnus contra contra** Linnaeus. Indian Pied Myna.

We had not been able to observe the Pied Myna in Nepal. However, Scully (1879, pp. 329-330) found it during his days as 'fairly common about houses in the Hetoura [=Hitaura] Dun', and to be 'very common in the Tarai and plains of central Nepal, in winter'; and Ripley (1950b, p. 413) observed it as 'common throughout the Terai [? including central] in gardens and near cultivation' in winter. Rand & Fleming (1957, p. 193) obtained a single specimen from the tarai of western Nepal.

740. **Acridotheres tristis tristis** (Linnaeus). Common Myna.

TARAI: Simra: 1 ♂ (March 4). BHABAR: Amlekhganj: 1 ♀ (March 10). DUN: Hitaura: 1 ♂, 1 juv. ♂, 4 ♀♀, 1 juv. ♀ (May 15, 30-June 16, July 14, 20). CHITLANG VALLEY: Chitlang: 3 ♂♂, 1 ♀ (April 16-22). NEPAL VALLEY: Burhanilkantha, Kathmandu, Thankot: 3 ♀♀ (March 21, 23, May 1).

The Common Myna is a very common bird of central Nepal about human habitation up to about 1830 m.

Ripley (1950b, p. 413) has recorded it throughout Nepal up to *c.* 1830 m. Rand & Fleming (1957, pp. 193-194) have noted it in western and west-central Nepal up to *c.* 1525 m. Biswas (1960a) has found it in eastern Nepal up to *c.* 1830 m.

The March birds had non-breeding gonads, but the May and June birds had them in fully breeding condition.

Colours of soft parts: Iris brown to reddish brown, spotted with pale yellow; orbital skin bright yellow; bill yellow with black or greenish black on base of both upper and lower mandibles or of the latter alone; legs and feet yellow; claws horny; pads white.

Measurements: 3 ♀♀: Wing 140, 147, 151; tail 84, 88, 90; bill 26(2),—.

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[1] An earlier name *Sturnus indicus* Blyth, 1843 (*Ann. Mag. nat. Hist.* **12**: 97, ex Hodgson MS. and in Gray's *Zool. Miscellany*, 1844, p. 84, *nomen nudum*) has been frequently used for this bird, e.g. Baker (1930, p. 211), Ripley (1961, p. 299), among others. According to Blyth's description, the bill of *indicus* 'never becomes yellow at any age'—a character not known in any of the subspecies of *S. vulgaris* recorded from the Indian region. Again, more than one subspecies of the species occurring in this area do not have yellow bill in winter, but whether Blyth referred to only winter migrants is far from clear from his writing. However, he later (1852, p. 109) changed his opinion and treated '*Sturnus indicus*' as a synonym of *S. vulgaris.* A search for the specimens of the species he had at his disposal prior to describing *indicus* (namely two specimens purchased in Calcutta brought 'probably from Rajmahl' and one from Nepal, presented by Hodgson) proved abortive, so that the correct identification of Blyth's *Sturnus indicus* is not feasible at present. Under the circumstances, it is best treated as unidentifiable to subspecies, as suggested by Amadon (1962, p. 109).

*741. **Acridotheres ginginianus** (Latham). Bank Myna.

The post-Hodgsonian records of the Bank Myna from Nepal consist of Rand & Fleming's (1957, p. 194) observation in the western and eastern tarai in winter, and Biswas's (1960a) in the Likhu Valley, Chautara district, central Nepal, at *c*. 1220 m. in January.

742. **Acridotheres fuscus fuscus** (Wagler). Northern Jungle Myna.

Pastor fuscus Wagler, 1827, *Syst. Avium, Pastor*, sp. 6. (India, restricted to Eastern Bengal by Baker, 1921b, p. 702.)

TARAI : Simra : 1 ♂ (March 5). DUN : Hitaura : 1 ♂, 3 juv., ♀♀ (June 14-16). NEPAL VALLEY : Burhanilkantha, Godavari, Thankot: 4 ♂♂, 3 ♀♀ (April 2-12, May 1-13).

The Jungle Myna is not uncommon in central Nepal. It occurs in pairs or loose flocks on the edges of forests or inside light forests.

Rand & Fleming (1957, p. 194) recorded it from west-central and eastern Nepal at *c*. 290-915 m. in winter.

My three juvenile specimens are without crests, but have brown on the dorsal side and have brownish tinge on the chin.

A female specimen (Godavari, May 11) is regenerating all its tail feathers, evidently accidentally lost.

Specimens taken in May had breeding gonads.

Colours of soft parts : Iris bright yellow ; bill orange-yellow with black on the base of the upper and on the basal half of the lower mandible, and with whitish tip ; legs and feet yellow ; claws light horny with darker tips (once yellowish horny on base and horny distally) ; pads white.

Measurements :

	Wing	Tail	Bill
6♂♂ :	122(2), 127, 128, 129,130	72(2), 74, 75, 75.5, 76	26, 26.5(2), 27(2), 28
3 ♀♀ :	120, 124(2)	71.5, 72,—	25, 26, 27

I would agree with Amadon (1956, pp. 32-33 ; 1962, pp. 113-114) in considering *fuscus, grandis, albocinctus*, and *cristatellus* as distinct species, *contra* Marien (1950b, p. 483) and Biswas (1953, p. 55).

It may be pointed out in passing that if *fuscus* Wagler and *grandis* Moore are treated as conspecific, the former name must be used as the specific name because of its priority by 31 years over the latter.

743. **Gracula religiosa intermedia** A. Hay. Northern Hill Myna.

BHABAR : Amlekhganj : 2 ♂♂, 1 ♀ (March 9, 10). DUN : Hitaura, Pahare Ghat : 2 ♂♂, 1 imm. ♂, 2 ♀♀, 2 imm. ♀♀ (May 20-June 12).

The Hill Myna is occasionally met with in the bhabar and duns of central Nepal. During May and June, it was seen by us in the Hitaura dun in parties of six to about a dozen birds on *Ficus* trees.

Ripley (1950b, p. 413) came across it in the eastern tarai in winter, and Rand & Fleming (1957, p. 193) in the central dun in April.

The March specimens are in fresh plumage, but the May-June ones are worn.

One of the immature females (May 25) is undergoing post-juvenile moult which appears to be rather late.

The gonads of a male and a female example taken June 12 suggested that their breeding was already over; the ovary was exhausted, and the testes somewhat reduced in size.

Colours of soft parts : Iris dark brown (grey-brown in juvenile); bill orange to reddish orange, yellow on tip (in juvenile yellowish orange, dusky on culmen and anterior half of the upper and yellow on tip of the lower mandible); bare skin on head and wattles bright yellow (lemon-yellow in juvenile); legs and feet yellow; claws dark horny, paler on bases; pads pale yellow.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	166, 166 +, 169, 176	78, 84, 85, —	31, 31.5, 32(2)
3 ♀♀ :	163, 169,—	80, 84,—	31, 32, 32.5

Family ORIOLIDAE

744. **Oriolus oriolus kundoo** Sykes. Indian Golden Oriole.

NEPAL VALLEY : Thankot : 1 imm. ♂ (April 14).

The Indian Golden Oriole did not appear to be a common bird of central Nepal during our stay there. Scully (1879, p. 298) observed it between April and August in the Nepal Valley frequenting the central woods, gardens, and groves. The only other post-Hodgsonian record of the species from Nepal is Proud's (1949, p. 709) who noted it breeding on the hills surrounding the Nepal Valley.

The specimen under report appears to be a first-year bird; it conforms to the account given by Whistler (1936a, p. 497).

*745. **Oriolus chinensis tenuirostris** Blyth. Slenderbilled Oriole.

It appears that Scully (1879, pp. 298-299) was the first to record the Slenderbilled Oriole from Nepal. He found it fairly common in the Nepal Valley from October to March, and thought that it probably bred there on the Sheopuri Lekh. Proud (1949, p. 709) observed it only occasionally in the Nepal Valley in January-February. Rand & Fleming (1957, p. 108) took a single example in the eastern tarai in December.

746. **Oriolus xanthornus xanthornus** (Linnaeus). Indian Blackheaded Oriole.

TARAI : Simra : 1 ♀ (March 5). BHABAR : Amlekhganj : 1 ♂ (June 8). DUN : Hitaura, Kusumtar, 1 ♂, 3 juv. ♂♂, 1 ♀, 1 juv. ♀, 1 juv. unsexed (May 12-June 4).

The Blackheaded Oriole did not appear to us to be particularly common in central Nepal, at least during May-June. It occurred in the tarai, bhabar, and dun singly or in pairs in the deeper parts or on the edges of forests, as well as in groves about cultivation.

Scully (1879, p. 299) noted it in the central plains up to the duns in winter; Ripley (1950b, p. 414) in the tarai in March; and Rand & Fleming (1957, p. 107-108) in west-central and eastern Nepal from *c.* 275 to 1370 m. winter.

An adult male taken June 8 had fairly developed testes.

Immature specimens :

(*a*) ♂ (June 4), unsexed (June 4) : Primaries black; the first one from outer side without edging; second narrowly edged white on the outer web and tip; third to sixth edged yellow proximally, white distally, and mixed yellow and white on tips; other primaries and secondaries with yellow on outer edges and tips. Iris grey-brown, bill black. Gonads of the male rudimentary.

(*b*) ♂ (May 27) : Similar to (*a*) but yellow on lower breast and flanks, and whitish on abdomen and vent. Bill black (in dry skin). Colours of other soft parts and condition of gonads not noted.

(*c*) ♂ (May 17) : Primaries dark brown; the first one without edging; second to sixth edged with white, second one very narrowly, and tips without yellow; other primaries and secondaries edged yellow. Underside from lower breast posteriorly yellow. Bill fleshy pink (in dry skin). Colours of other soft parts and condition of gonads not noted.

(*d*) ♀ (June 3) : Primaries brown; secondaries faintly edged with yellow; breast, abdomen, and vent yellow, slightly less rich than the upper side. Crown typical of first-year bird as described by Whistler & Kinnear (1933a, p. 584). Iris crimson, bill fleshy pink. Ovary enlarged (9 × 5.75 mm.) but appeared spent (with a few granular ova), suggesting it might have bred recently.

Blackheaded Oriole in first-year plumage, then, do breed (?occasionally, ?regularly). It would appear that such breeding first-year birds have adult coloration of the iris and bill. It is possible that the juvenile male of May 17 ('*c*' above) with fleshy pink bill might also have bred recently, although there is nothing to prove it. It occurs to me that Baker (1926, p. 12) based the description of the adult female on first-year female specimens with positive breeding data on their labels.

Colours of soft parts: Iris crimson; bill fleshy pink; legs and feet deep plumbeous; claws black; pads white.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	143 (2)	96, 99	31.5, 32
2 ♀♀ :	137, 139	92, 93	30, 31

Biswas (1949, pp. 233-234) and Rand & Fleming (1957, p. 108) have questioned the validity of the intermediate subspecies *maderaspatanus* Franklin, which was revived by Whistler & Kinnear (op. cit., p. 585) and upheld by Ripley (1961, p. 285). Greenway (1962, p. 134) is, however, doubtful as to its distinctness.

747. **Oriolus traillii traillii** (Vigors). Himalayan Maroon Oriole.

Pastor traillii Vigors, 1832, *Proc. zool. Soc. Lond.* (1) : 175. (Himalayas, restricted to Darjiling by Baker, 1921b, p. 698.)

DUN : Bhimphedi: 2 ♂♂, 1 juv. ♀ (May 5-8). MARKHU VALLEY : Deorali : 1 ♂ (May 2). NEPAL VALLEY : Thankot: 3 ♂♂, 1 juv. ♂, 2 ♀♀ (March 21-26, April 1-7).

The Maroon Oriole is not uncommon in the dense forests of central Nepal above *c.* 1370 m. during March-May. It usually occurs singly.

Ripley (1950b, p. 414) observed it in the duns and foothills of western and eastern Nepal in winter. Rand & Fleming (1957, p. 167) recorded it also from west-central Nepal at *c.* 2440 m. in December.

It was breeding in early May in central Nepal.

The juvenile male listed above is a first-year bird. Its testes were somewhat enlarged (8 mm.) on March 26.

Measurements :

	Wing	Tail	Bill
6 ♂♂:	141, 147 (2), 148, 152, 153	104, 107, 109, 110 (3)	32 (4), 32.5, 33
2 ♀♀ :	147 (2)	110, 112	31, 32.5

(*To be continued*)

The Indian Cho Oyu Expedition, 1958 : Observations of a Botanist Member

BY

SESHAGIRI RAO ROLLA

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(*With four plates and a sketch map*)

In the middle of January 1958, I was asked by the Chief Botanist, Botanical Survey of India, if I would accompany as a Botanist Member the Indian Cho Oyu Expedition, 1958, the first Government-sponsored expedition in the history of Indian mountaineering. I was delighted at the prospect, as the expedition would give me an opportunity to visit not only Nepal, which I had not till then visited, but more particularly the high valleys between Mt. Everest and Mt. Cho Oyu, the sixth highest peak in the world, with all their magnificent snow peaks and their glorious sights which only the very fortunate have ever seen. But I fully realised the various responsibilities attached to such a commitment and the heavy strain I would have to undergo during the expedition at the age of thirty-eight, possibly the oldest, I then thought, among the various members of the Expedition. However, with my earlier experiences in the eastern Himalayas, I felt confident that I would be able to do well in this expedition also. But above all these feelings, the great passion for the Himalayas which I had developed during my previous explorations was the main attraction for me and I answered in the affirmative without any hesitation.

APPROACH MARCH TO NAMCHE BAZAR

After necessary arrangements at Shillong and Calcutta, I reached Kathmandu on 19 March 1958 where, after a couple of days, I met the rest of the members of the Expedition, namely Shri Keki Bunsha,

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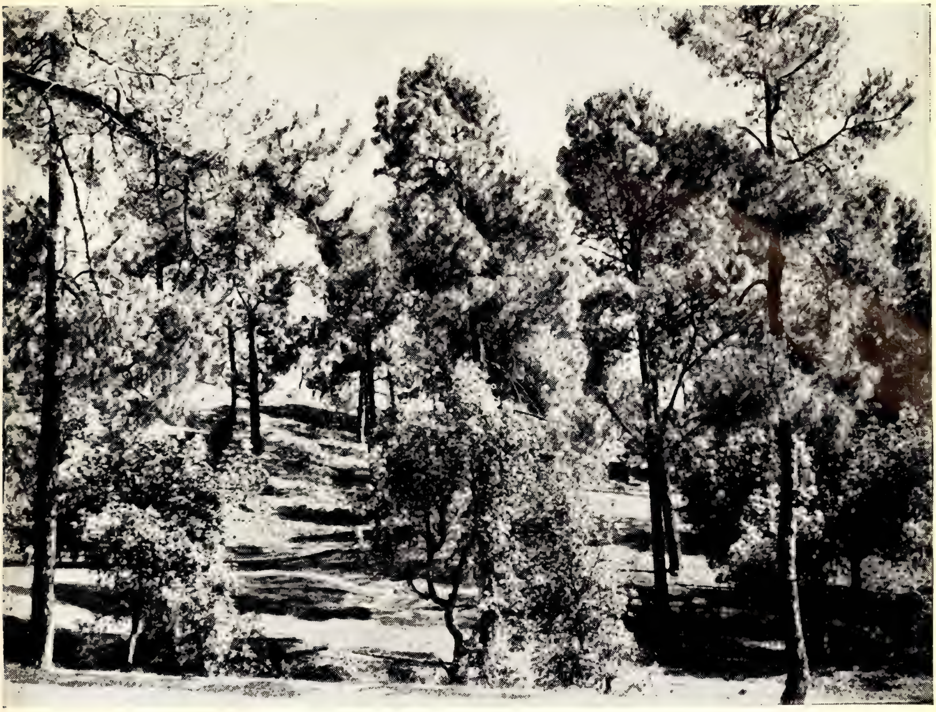
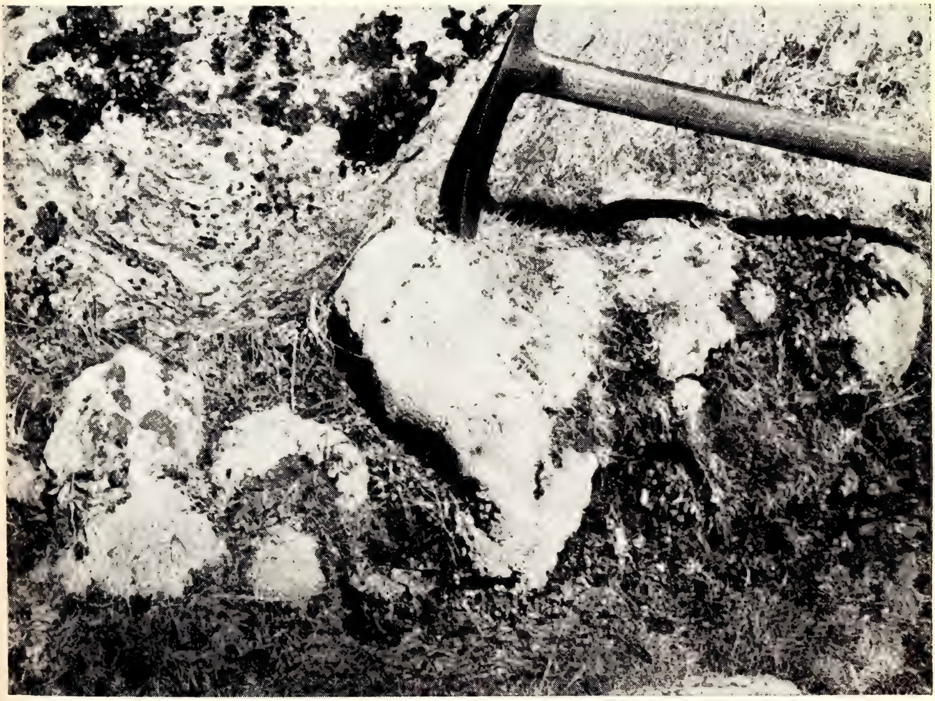


1. Forest of *Pinus wallichiana* along slopes between Phokte and Nandu : 1350 m.



2. Hard, hemispheric clumps of *Arenaria musciformis* an important component of alpine moorland vegetation on rocky moraine between Lobuche and Gorashap : 5000-5200 m.

(*Photos : R. S. Rao*)

1. *Rhododendron arboreum*, a common associate in pine forests and abundant along slopes: 1350-2000 m.

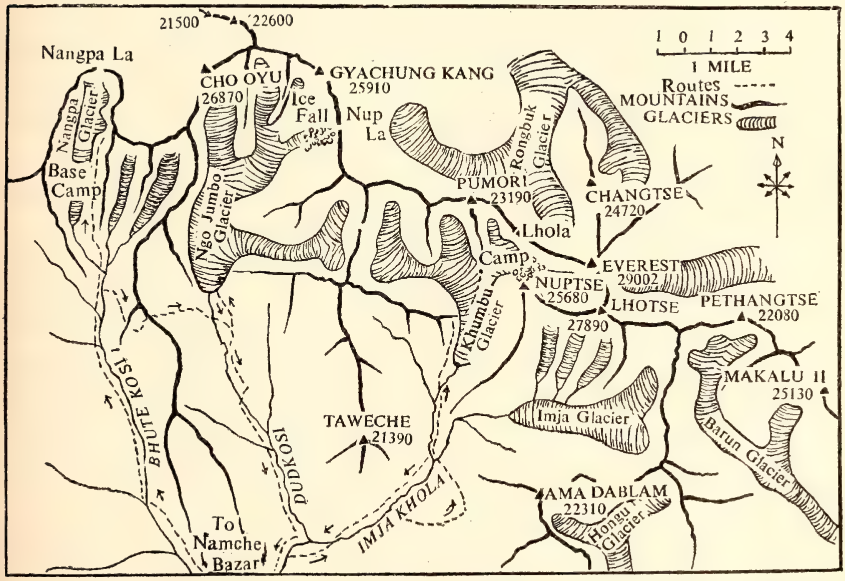
2. *Rhododendron* sp. stems thickly covered with moss, typical of temperate vegetation along slopes between Shete and Jumhesi: 3300-3500 m.

(*Photos : R. S. Rao*)

Capt. John Dias, Shri Sonam Gyatso, Capt. Jagjit Singh, Dr. R. M. Boal, and Shri A. K. Dutta. Maj. N. D. Jayal, who unfortunately died during the expedition, proposed to meet the party later at Namche Bazar by trekking via Jayanagar. Along with other friends, I met Sirdar Pasang Dawa Lama, the Sirdar of our Sherpas, a very brilliant mountaineer with several expeditions to his credit, who climbed Mt. Cho Oyu in 1954 along with the leader of the Austrian expedition. On 24 March, while we were packing our materials for leaving Kathmandu, we heard of the crashing of the plane bringing our equipment to Kathmandu. Valuable equipment and particularly photographic materials were lost. In spite of this mishap, we left Kathmandu on 26 March, as scheduled, after a pleasant farewell by the Indian Ambassador there. By then I came in contact with Shri Chakraprasad Sharma, a young Nepali liaison officer with pleasant manners and with many of our Tiger sherpas of Darjeeling, such as Aung Nima, Danru, and the famous cook of several expeditions, Thondup, with his 'Didi', the wife of Aung Nima, as his helper who have excellent records in various expeditions.

After leaving Kathmandu we followed the route along the upper valleys of eastern Nepal above River Sun Kosi and passed through several villages of Tamang Nepalis. The various hill slopes along the track have been mercilessly cleared of vegetation for terrace cultivation and, in such dry season with barren appearance all around, small bushes of *Hypericum* offered a delightful sight with their bright yellow flowers. The people are quite simple and pleasant. The women made quite a good business by selling to our one hundred and twenty porters their light intoxicating drinks (*jhand* and *rakshi*) made of millet, rice, or wheat. After crossing the two rivers, Indravati and Sun Kosi, at Dolaghat at an altitude of 720 m. we passed through a few interesting villages, like Resingo where the inhabitants are known as Newar Nepalis. At Dumre village, the village school boys together with their teacher were happy to pose for my camera enjoying the peppermint sweets I distributed. Along the track the Blue Pine, *Pinus wallichiana* (Plate I, fig. 1), and *Rhododendron* forests particularly of *R. arboreum* (Plate II, fig. 1 and 2) with their beautiful red and pink flowers are common. Orchids on tree branches, though not very common, are represented by a few species of *Vanda, Cymbidium, Dendrobium*, and *Coelogyne* in bloom. Along the surrounding terraced valleys, wheat is the standing crop ready for harvest during this period of the year, and potato and maize are in the seedling stage. Of the various wild animals panthers are quite common and trouble the villagers, who have erected interesting traps made of stone walls and wooden doors for trapping them. After a few days' march, sometimes crossing deep gorges by delicate single-chained bridges of thin wooden slats which swung up and down with the weight of even one man, we reached Megchen, otherwise called Those, at an altitude of 1800 m., the well-known Newar town of eastern Nepal. The blacksmiths of this village were once famous for the manufacture of country guns, a variety of Nepali kukris, and other metallic weapons. The iron ore which forms the main source for making metal weapons is available in considerable quantities along the upper slopes of this area. After a couple of days' march or so, we entered the Sola Khumbu area, the land of the Sherpas. The Buddhist monasteries known as *Gompas* began to appear along the various Sherpa villages. After crossing Jumbesi at an altitude of 2800 m. a typical Sherpa village with no Nepali element at all, we started trekking along the higher valleys covered with beautiful temperate vegetation consisting of *Pinus wallichiana, Rhododendron barbatum, R. grande,* and a few other species, *Magnolia campbellii, Abies spectabilis, Taxus baccata, Tsuga brunoniana,* and shrubby species of *Berberis, Daphne,* and others, and small herbs of *Primula denticulata, P. walshii, P. sculliyi, Oxygraphis polypetala,* and several others, most of them in their full bloom. Large pearl-white flowers of *Magnolia campbellii* at the tips of bare leafless branches look like twinkling stars against the background of the green foliage of other trees. *Rhododendron* shrubs with flowers of a variety of colours and tiny *Primula* and *Ranunculus* herbs with their myriads of flowers spreading on wide grassy meadows are a sight to see and enjoy. On 7th April night, I felt a little unwell. Thinking that I was well enough to undertake the strenuous march of nearly 11 miles with the entire camp, I moved off quite early next morning. On the way I felt unusually sick with high temperature and diarrhoea. The journey I made on that day is one of the most strenuous I have ever made. But, with a little rest in the night and a few pills of medicine, I could manage more or less satisfactorily on the next day. On the way, between Khari-Khola and Painya, we met some youths of Rai Nepali community who looked very different from other Nepalis with their profuse ornaments in the form of metal bangles, rings, ear rings, using many of the silver coins of Nepal for decoration. Subsequently, after a few days' trekking we reached Namche Bazar situated at an altitude of 3300 m., a grand village of about 100 Sherpa houses, on 11 April 1958.

Namche Bazar, without really a bazar in the village, has secured a quite prominent place in the history of mountaineering in Nepal. The villagers are quite familiar with several expeditions and greeted us with their usual characteristic smiles. Though it was snowing while approaching this village, when once it cleared late in the evening the yellow rays of the evening sun glistening on the surrounding snow peaks of Kwangde and Kwangtiga and the adjacent ranges presented them as masses of gold. The steep rocky peak right above the village called Kumbi La is highly revered as the presiding Deity of the Sola Khumbu area. After climbing a small hill above our camp site we saw for the first time the whole view of the Imja Khola valley with Mt. Ama Dablam on one side and the Lhotse-Nuptse wall further away with the pyramidal top of Mt. Everest just behind the wall. The sight was really most enchanting in the evening light.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The three high valleys—Imja Khola, Dudh Kosi, and Bhute Kosi—between Mt. Everest and Mt. Cho Oyu with rocky ranges and glaciers in between, showing the route followed by the scientific party of the expedition.

Exploration along the high valleys between Mt. Everest and Mt. Cho Oyu

After considerable planning it was decided that the scientific party would explore the three important valleys of the rivers Imja Khola, Dudh Kosi, and Bhute Kosi situated in between Mt. Everest and Mt.

Cho Oyu while the climbing party would attempt to climb Mt. Cho Oyu situated very near to Nangpa La along the border of Nepal and Tibet. We were told that Major Jayal would join the climbing party at the Base Camp of Cho Oyu. After giving a nice send off to our climbing friends on 14 April and after meticulous planning we started off along the Imja Khola Valley on 16 April. Our first halt was at the Buddhist Monastery of Teng-Poche situated at 3900 m., a very important *Gompa* for the Sherpas with the most revered Avatar Lama as the head-priest of the Monastery. The Monastery is quite an impressive one with the largest and holiest temple on the top of the mound in the centre surrounded by small rugged Tibetan houses and hutments of the Lamas and with the usual decorated entrance and chorten. Overlooking the Imja Khola Valley it is set in most beautiful and picturesque surroundings with Mt. Ama Dablam standing out prominently at a very close distance. The monastery, founded in 1915-16, the Tibetan Fire-Dragon year, is meant for the Lamas only and there is a very severe restriction that no female should stay within the premises of the *Gompa* at night. Even our girl porters who were casual visitors at that time had to leave the monastery for the night after helping our cook in the kitchen. The next day we passed through another *Gompa* meant for Laminis (nuns) only at Dibuche at an altitude of 3850 m. On the way at Pangboche we saw the famous Yeti[1] scalp carefully preserved in the village monastery.

While camping near Mingbo at an altitude of 4500 m. just under the shadow of Mt. Ama Dablam along the grassy mounds, with grazing yaks all around, the scenic beauty is most enchanting, and the sight of gigantic Mt. Ama Dablam on one side and Mt. Tawache on the other, watching the valley like two snowwhite sentinels, is a remarkable feast to the eyes. These two peaks though below 7300 m. are still unconquered[2] owing to the dangerous hanging glaciers near their tops.

As we climbed up further along the Chola Khola Valley and proceeded along the Lobuche Khola Valley towards the Everest area the beautiful peaks of Pumori, Lingtrense, Kumbutse, Nuptse, with the gigantic Everest still hiding behind Nuptse, were the constant sight before us infusing vigour and enthusiasm into us and inviting us to approach them more briskly. The vegetation along the edges of the Khumbu glacier is very sparse, consisting of stunted, tiny plants of *Rhododendron anthopogon, R. lepidotum, Ephedra saxatalis, Cassiope*

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[1] The Abominable Snowman. *J. Bombay nat. Hist. Soc.* **52** : 594-598 ;' Scalp ' of the Abominable Snowman. ibid. **58** : 261-263.—Eds.

[2] Mt. Ama Dablam was climbed by a British Expedition in 1961.—Eds.

fastigiata, Juniperus wallichiana, Gentiana albicalyx, Caragana crassicaulis, Ranunculus pulchellus, Sedum quadrifidum, Anaphalis xylorhiza, Arenaria musciformis in hard, hemispheric, creamy-white patches (Plate 1, fig. 2), and several others. A little further along the Khumbu glacier, the region turns out to be a rugged and barren rocky moraine terminating in an extensive glacier moraine covered with loose rocky boulders mixed with very loose sand covering the solid icy masses at the bottom. There is no definite path and the track had to be made by us according to the stability of the rocky boulders with huge icy blocks beneath. Vegetation is practically absent from this area. Very near our camping site at Gorashep situated at an altitude of 5300 m., right under the shadow of Mt. Nuptse and Mt. Everest, there is a very extensive sandy bed evidently formed by the constant weathering of rocks and frequent covering of the area by glacier waters. Here the hard icy glacier lake, the edges of which consisted of chiselled icy pieces as sharp as broken glass, was an interesting sight. Owing to the high altitude some of the members suffered from severe headache and a feeling of sickness, but they recovered to a certain extent after a short period. Subsequently I climbed the adjacent mountain top with an altitude of 5600 m. to see some of the finest views of Mt. Everest. The view of Mt. Everest with Khumbu Ice Fall just above the glacier, along the edge of which a track for climbing Mt. Everest was formed by the recent Everest Expeditions, including the successful ones, and a small part of South Col further back gave me immense pleasure in spite of all the strain I had undergone in climbing that mountain top under such altitude conditions. Vegetation along these slopes becomes extremely sparse and develops into thick, hard clumps of short, stunted species such as *Sedum crenulatum, S. himalense, Stellaria decumbens, Anaphalis xylorhiza, Saussurea tridactyla, Saxifraga imbricata,* and alpine grasses like *Festuca valesiaca, Deyeuxia pulchella,* mixed with a few moss species and lichens[1] like *Cladonia* sp., *Stereocaulon myriocarpum* var. *orizabae, Cetraria everniella, Usnea hookeri* a rare species in the Himalayas but more common in Tibet where it is used for dyeing wool, bone-white worm-like *Thamnolia vermicularis* which is used as an offering while praying in monasteries, and also the new records for this area of east Nepal, *Sticta henryana* and *S. platyphylloides* which are so far recorded from China only. Such compact development resists the extremely rigorous conditions of life existing in such high altitudes.

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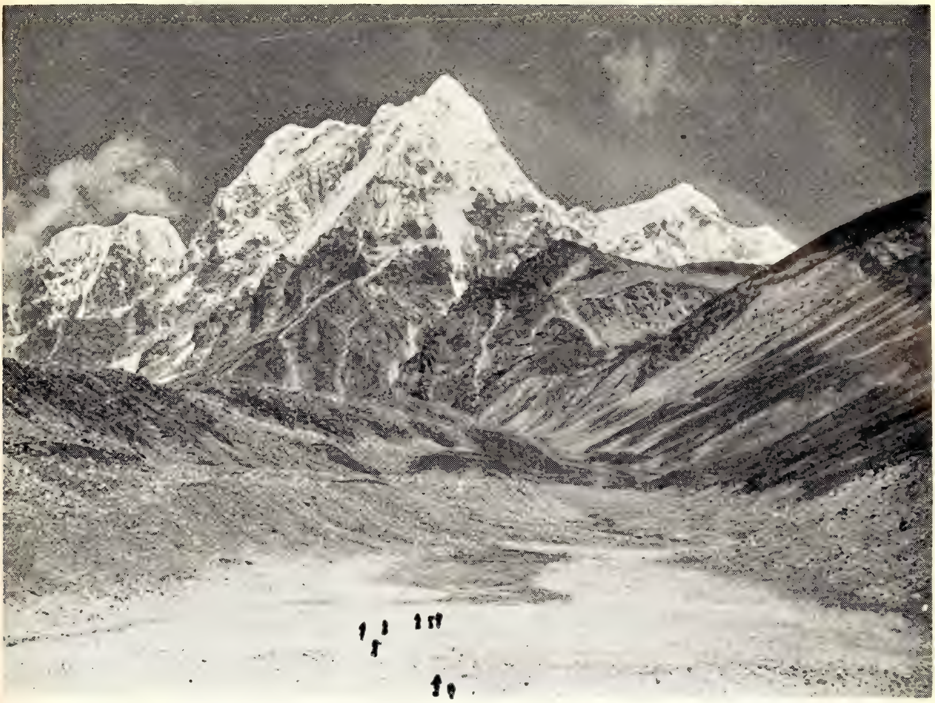
[1] For more details of lichens collected during this expedition, reference may be made to the paper 'On a collection of macrolichens by the Indian Expedition to Cho Oyu, East Nepal' by D. D. Awasthi [1960, *Proc. Indian Academy of Sciences* **51** : 169-180].

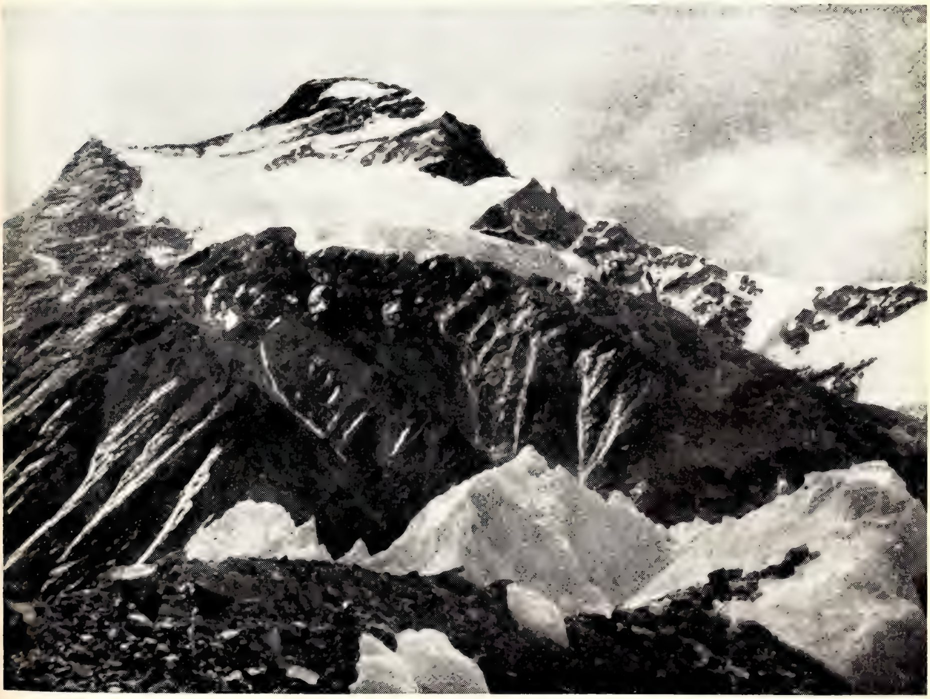
On our way back to Namche Bazar we paid our respects to the Avatar Lama at Teng Poche Monastery, who very kindly enquired about our movements and the welfare of the expedition members who were then climbing Cho Oyu. We reached Namche Bazar on 30 April and heard the shocking news about the death from pneumonia on the 28th at camp I on Mt. Cho Oyu of Maj. Jayal, one of the best mountaineers of our country.

During three weeks of May we wandered about the Bhute Kosi and Dudh Kosi valleys carrying out scientific exploration right up to the points of Nangpa La glacier and Ngojumbo glacier near Dudh Kosi lake. Camping near snows under very cold conditions with the night temperatures getting down to −7° C. along the uppermost regions of these valleys was really an interesting experience. The surroundings of Nangpa La (Plate III, fig. 1), probably the highest pass in the world at an altitude of 5600 m., with an extensive glacier and enormous white snowy bed present an amazing sight with its perfect beauty blended with dreadful loneliness. This is the main trade route between Nepal and Tibet along which commodities are transported in summer by yak, the only animal that can move safely on such a snowy pass.

After cutting across the Bhute Kosi Valley we reached Mosumba Lake situated at an altitude of 5100 m. on 12 May and planned out our track to cross the rocky range at Tak Marpo separating Bhute Kosi Valley from the Dudh Kosi Valley. Even along such slopes littered with huge rocky boulders, small clumps of *Saussurea graminifolia* (Plate IV, fig. 2), with their fleecy white hairy covering, and hard hemispheric or globose white balls of *Arenaria musciformis* struggle very hard to survive along the rocky crevices and corners with suitable soil cover. This area is completely uninhabited and the *Daily Mail* Expedition in 1956 in search of the Yeti crossed this range at this point for the first time. Though we had no special equipment, such as ropes etc., we attempted to cross the range though certain parts of track were extremely dangerous with narrow loose rock formation. However, we toiled hard along this steep slope and, after reaching the top at an altitude of 5500 m., saw the most glorious sight of the world with the entire panorama of giant snow peaks consisting of Everest, Ama Dablam, Gyachung Kang, and several other surrounding peaks. The glistening blue waters of Dudh Pokhri Lake right below us with Ngojumbo glacier in the background made the view all the more wonderful. Dudh Pokhri, which is about 2 miles long and a mile broad, is regarded by the Sherpas as their

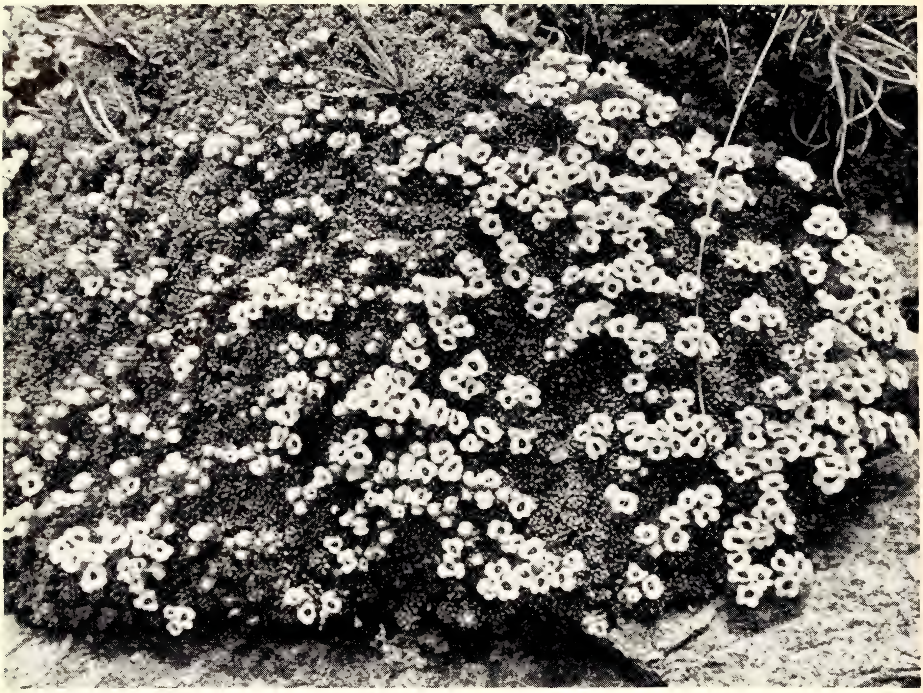


1. Panoramic view of Lonak Valley on way to Nangpa La

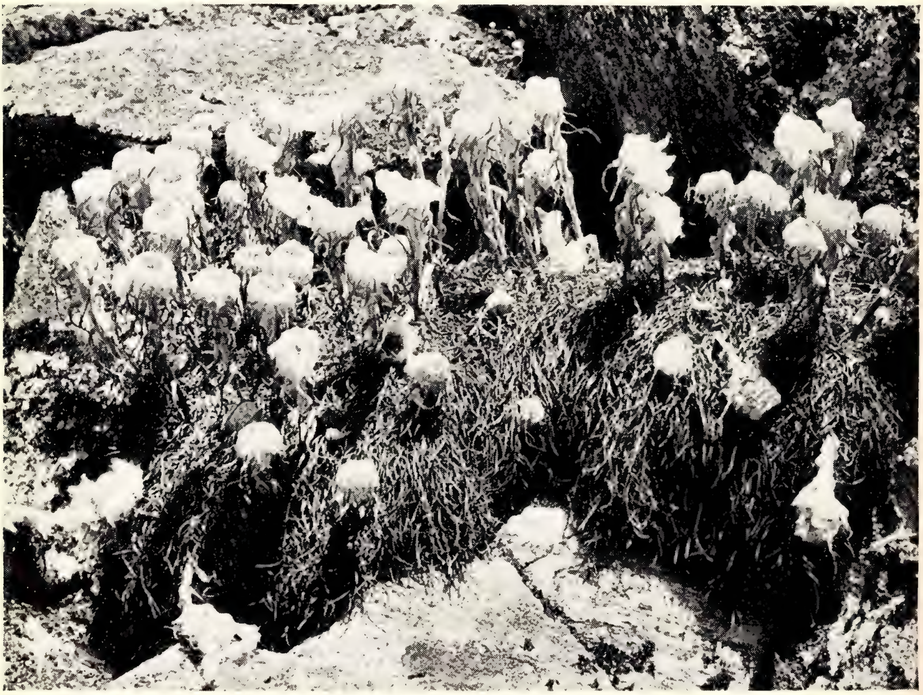


2. Mt. Cho Oyu (8189 m. = 26867 ft.)

(*Photos : R. S. Rao*)



1. *Saxifraga ramulosa* growing on the slopes between Dudh Pokhri and Dole : 4840 m.



2. Small colony of *Saussurea graminifolia* in rocky moraine between Mosamba Lake and Lhenjo : 5120 m.

(*Photos : R. S. Rao*)

most sacred lake, and all our porters believe strongly that if one circles round the lake once and prays to the Goddess of the lake asking for a boon it will certainly be granted. Interesting species of insects and algae growing even in the icy cold waters of lakes and ponds at an altitude of 5000 m. have been collected. Ducks[1] such as *Aythya fuligula, A. ferina,* and *Tadorna ferruginea* were seen in very small numbers on the waters of Dudh Pokhri. On our way down from Dudh Pokhri to Dole along 4700 m., clusters of *Saxifraga ramulosa* forming clumps on moist rocky slopes with tiny white flowers are a beautiful sight indeed (Plate IV, fig. 1). After general survey work along the valley we returned finally to Namche Bazar on 16 May.

EXPERIENCES OF THE SUCCESSFUL CHO OYU CLIMBERS AND RETURN MARCH TO KATHMANDU

The 17th of May was the happiest day for us when the news reached us by wireless that Sonam Gyatso, a member of our team, and Sirdar Pasang had reached the top of Cho Oyu on the 15th at 3.30 p.m. Later, on the 20th, all the climbing members with their flags of Mt. Cho Oyu, Nepal, and India flying on their haversacks were heartily received at Namche Bazar. While approaching the village the Lamas of the *Gompa* welcomed the climbers in their traditional style with the blowing of long trumpets and conch shells and beating of huge drums. It was really a strange sight to see the various members with their weather-beaten faces, skin peeling off, and extremely exhausted. They had had a very tough time on the mountain with unusually strong winds blowing over their tents at an average speed of 50 miles per hour, though they had a favourable sun on most of the days.

A word about the Sherpas with whom we moved so closely all these months on very affectionate terms. They are a fine people with a jovial nature and everlasting smiles on their faces. The high Himalayas are their place of birth and play. It is sometimes most surprising to note their extraordinary lung power, together with their capacity for withstanding the enormous strain of mountain climbing with loads of 30 kg. at elevations of 4600-6000 m. and about 20 kg. at 6000-7000 m. The heroic part played by many of the Sherpas in various expeditions in the Himalayas is well known.

During the return march, we followed a different track along the higher valleys on the right flank of Dudh Kosi river passing through camping places called Tate, Hesingnasa, and Tanga. The vegetation, consisting of *Pinus wallichiana, Tsuga brunoniana, Abies spectabilis,* and a few species of *Rhododendron,* is typically of temperate type. The region along the highest altitude of 4600 m. reached along this route above Tanga presents a characteristic alpine moorland vegetation with wide grassy slopes and interesting flowering species of *Pedicularis, Cochlearia, Potentilla, Anemone, Primula,* and a few others. Subsequently, we joined the approach march route at Junbesi and, while following the track along lower altitudes, interesting species of fish were collected from the small streams by Shri Dutta, the Zoologist member.

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[1] The writer's thanks are due to Dr. B. Biswas of the Zoological Survey of India, Indian Museum, Calcutta, for the identification of bird species.

We reached Kathmandu on 15 June and were warmly received both at Kathmandu and subsequently at Delhi. Our Prime Minister on one of the occasions connected with mountaineering observed that India is nourished by mountains and seas and if the people of the land become afraid of mountains and seas they will fall. The Expedition was really an arduous one but it has remained a memorable experience, not because of the sense of achievement but because of the virtues it taught—bravery in the face of danger and a feeling of fellowship.

SUMMARY

The Indian Cho Oyu Expedition, 1958, was sponsored and financed by the Government of India. The members of the Expedition were Shri Keki Bunsha (a solicitor from Bombay—Leader), Capt. John Dias (Indian Army), Shri Sonam Gyatso (Government of India), the late Maj. N. D. Jayal (Principal, Indian Mountaineering Institute, Darjeeling), Capt. Jagjit Singh (Indian Army), Shri R. M. Boal (a physician from Bombay), Shri A. K. Dutta (Zoological Survey of India), and Shri R. S. Rao (Botanical Survey of India). This Expedition team was ably assisted by Shri Pasang Dawa Lama as Sirdar of the Sherpas. All the members of the party except Maj. Jayal (who later joined the party at the base camp of Mt. Cho Oyu) assembled at Kathmandu. The entire Expedition, including approach march, botanical and zoological survey by the scientist members, assault on Mt. Cho Oyu, and return march to Kathmandu, was carried out during the period from 26 March to 15 June, 1958.

During the approach march to Namche Bazar, altitudes ranging from 1525 to 3660 m. (5000 to 12,000 ft.) were passed through. Along the earlier stages of the journey most of the mountain slopes presented

denuded vegetation due to extensive cultivation etc. Along the higher slopes with an altitude of 3000-3660 m. (10,000-12,000 ft.), typical *Rhododendron* forest mixed with species of *Magnolia, Berberis, Tsuga,* etc., most of them with their beautiful flowers, were observed. A few interesting details with regard to the various beautiful flowering trees, shrubs, and herbs characteristic of the temperate vegetation are discussed.

After reaching Namche Bazar, the party divided into two sections, the climbing section and the scientific section. While the climbing party was engaged in the successful assault on Mt. Cho Oyu, the scientific party surveyed three high valleys, namely the Imja Khola, Bhute Kosi, and Dudh Kosi valleys, right up to glacier points covering altitudes between 3660 and 5800 m. (12,000 and 19,000 ft.). Interesting floristic components, such as species of *Arenaria, Sedum, Festuca, Stellaria, Saussurea,* and several others developing as thick hard clumps along the typical alpine moorlands and rocky moraines, studied during this period are discussed.

The BNHS/WHO Bird Migration Study Project—3

Activities from 15-10-1962 to 15-4-1963

BY

SÁLIM ALI

Chief Investigator, BNHS/WHO Bird Migration Study Project

[*Continued from Vol.* **59** (3) : 929]

1. POINT CALIMERE AREA, MADRAS

In November 1962 I visited Point Calimere, about 200 miles south of Madras, and contemplated a project for ringing, and collecting parasitic arthropods from, migratory shore birds (Charadriidae) wintering in there. The work had to be postponed owing to a procedural hitch following the Madras Government's recent ban on all (commercial) netting. It is expected, however, that this will be resolved by the time the next autumn immigration is due. It seems particularly desirable to work with this group of migrants in India since very little is precisely known concerning their places of origin, migration routes, and local movements in their Indian winter quarters. Their significance here as potential disseminators of arthropod-borne viruses also remains to be investigated.

2. MAHIM, GREATER BOMBAY, MAHARASHTRA : 22 NOVEMBER 1962 TO 11 JANUARY 1963

The mangrove roost of migratory swallows at Mahim, Bombay [cf. Part 2, Section 2, *Journal* **59** (3) : 923] was re-occupied by the birds this season on or about 14 November 1962, i.e. about 9 months after its sudden abandonment on 8 February 1962. During 19 alternate evenings' netting between 22 November and 11 January, 1673 swallows, *Hirundo rustica*, were ringed, the majority belonging to the eastern race *gutturalis* with possibly a thin sprinkling of typical *rustica* as suggested by their heavier weight and larger wing measurements. Among the birds captured were six ringed at the same roost in February 1962, i.e. 9-11 months earlier, and 17 re-captured during the current session, i.e. from 4 days up to about 5 weeks after ringing. These data may be of some significance for the statistical estimation of the total number of swallows at the Mahim roost.

Visual estimation is subjective and pointless; all that can be said is that the number of birds present was positively stupendous! The roost grew progressively less populous after 24 December and was practically abandoned by the middle of January. It seems likely that the birds shifted to some alternative site subjected to less disturbance.

Again the swallows were found to be remarkably free from tick infestation. Of the 262 birds examined, not a single one proved positive. On the other hand 2 out of the 3 resident Cliff Swallows (*H. fluvicola*) taken at the same common roost showed a heavy infestation by Argasid ticks.

3. THE EDANAD WAGTAIL ROOST, KERALA : 8 DECEMBER 1962 TO 27 FEBRUARY 1963

The roost, described in Part 2, Section 1, *Journal* **59** (3) : 922 [see also *Journal* **59** (1) : 294] was, according to information, abandoned by the wagtails between 16 and 21 April 1962 although some suitable cane patches were still standing uncut. It became re-occupied some time between 20 October (when no birds were reported to be present) and 2 November, when they were found to be roosting 'in large numbers' in sugar cane of the stiff and broad-leaved Java variety. Local farmers, rather extravagantly, estimated the birds to be 8-10 times as many as in the previous season. On arrival at Edanad in early December, the BNHS field party estimated them to be twice or thrice as many, which may be nearer the truth. When I reached the camp on 28 January, the concentration was fantastic and there certainly *seemed* far more birds than in the previous season; but it is impossible to make an objective comparison. Work began on 8 December and continued till 27 February. At first the netting, ringing, and de-ticking of the birds were all done in a single operation in the evening, but later it was found more satisfactory to divide the work into an evening and a morning session—the first after the birds had settled in the cane at sunset, the second before they vacated the roost at sunrise. With the limited personnel available it was found more convenient to handle the captures in two batches, and this also enabled a more thorough search on the birds for ticks in daylight. The abundance of the birds can be gauged from the fact that during the 10 weeks' netting at the Edanad roosts the total number ringed was 20,380—all but 11 being *Motacilla* species. This excludes the 146 re-captures which were released after noting the serial number, weighment, and de-ticking. Except for 42 ringed in the Edanad area some months earlier in 1962, all of them were birds ringed during the current operation. In other words, taking 16 gm. as the average weight of a wagtail, the grand total represents a biomass of nearly 3.5 tonnes! The wagtails were mostly *Motacilla flava*, of races and quantities as follows:

M. f. beema	8624
M. f. thunbergi	7021
M. f. melanogrisea	376
M. f. simillima ?	1535
M. f. ssp.	2448

In addition there were:

Motacilla citreola	57
,, *caspica caspica*	1
,, *alba dukhunensis*	29
,, ,, ssp.	2
,, *indica*	276

The above break-up is indicative of the frequency of occurrence of the various species and races near the southern tip of the Indian peninsula. The comparative scarcity of the Forest Wagtail, *M. indica*, was noticeable. In the previous season, out of a grand total of some 6000 wagtails, 355 were of that species. It is interesting to note that in the case of one particular cane field—perhaps an acre in extent—a line of 5-6 nets was strung out along one edge of it in the identical place, morning and evening day after day practically throughout the 10 weeks of operation, without the catches showing the least sign of diminishing.

The Kerala camp, consisting of 3 members of the Society's field staff assisted by 5 or 6 local helpers for varying periods, deserves to be complimented on its notable performance. The work had to be discontinued on 28 February only because of our stock of rings becoming exhausted. Otherwise, there is no reason to doubt, we could easily have continued ringing at the rate of 300 to 500 wagtails per day till the time the roosts were abandoned for the season, reportedly about the middle of April. Indeed the roosting concentration of yellow wagtails is so stupendous on Edanad island that, with adequate personnel and organization, it would be no problem at all to ring 1000 birds per day for weeks on end between November and April.

From the tick collection point of view, the result was disappointing since the birds were again found to be largely free of infestation. Of the 12,919 birds examined, only 3 proved positive for ticks! In one case, the nymphs have been identified by the Virus Research Centre as of the species *Hyalomma isaaci*.

The Edanad camp was attended from 30 January to 6 February by Mr. R. McL. Cameron, Secretary of the Ceylon Bird Club, in order to familiarize himself with our mist netting and ringing techniques for starting similar work in Ceylon. It is hoped that the Ceylon project will develop at an early date and provide an important link in the network of migration study field centres which the Society is anxious to see functioning all over the country.

4. BHARATPUR, RAJASTHAN : 17 MARCH TO 9 APRIL 1963

A BNHS party of 3 field assistants, assisted by Yuvraj Shivrajkumar of Jasdan and one of his helpers from Saurashtra, resumed work on the sparrow roost in the area of scrub jungle known as Rund Sakitra near Kumher [cf. Part 2, Section 3, *Journal* **59** (3) : 924], and also at the previous reed-bed roost of wagtails in Keoladeo Ghana Breeding Waterbird Sanctuary. During the three weeks a total of 2366 migrant birds of 19 forms was ringed. They comprised chiefly the following:

Passer domesticus parkini (and/or *bactrianus* ?)	...	826
Passer hispaniolensis transcaspicus	...	416
Motacilla citreola	...	403
Motacilla flava beema	...	403
Motacilla flava thunbergi	...	27
Motacilla flava simillima	...	48
Motacilla alba dukhunensis	...	58
Acrocephalus stentoreus	...	15
Emberiza bruniceps	...	78

with fewer individuals of the following:

M. f. melanogrisea (8), *M. a. personata* (18), *Hirundo rustica* (2), *Riparia riparia* (1), *Erithacus svecicus* (1), *Acrocephalus agricola* (6), *Hippolais caligata* (1), *Sylvia curruca* (2), *Passer domesticus indicus* ? (52), and *Carpodacus erythrinus* (1).

Of all these, ticks were found only on a single *Hirundo fluvicola*—a heavy infestation of 64 nymphs. The specimens have gone for identification to the Virus Research Centre, Poona.

There is a move afoot for clearing and reclaiming for cultivation the low-lying scrub jungle which constitutes the sparrows' roosting area. Representations are being made to the proper authorities to leave undisturbed at least a portion of this unique natural bird sanctuary. It would indeed be a tragedy if this remarkable show place were allowed to disappear.

The wagtail roost among the sugar cane cultivation near Pengore village, at which some profitable ringing was done last autumn (ibid., p. 925) was no longer there at this season since all the cane had been harvested and the fields were completely dry. It is hoped that the new cane will be up and ready for occupation by the birds when the autumn immigration commences in September/October.

ROSY PASTOR ROOSTS IN ANDHRA

To verify reports of large roosting concentrations of Rosy Pastors in the extensive sugar cane plantations irrigated from the Nizamasagar Reservoir, and explore the possibility of netting, I visited the Anand Nagar farm in Nizamabad District [belonging to the Deccan Plantations (Prvt.) Ltd.] between 25 and 30 March 1963. Unfortunately it was rather late in the season for a correct idea to be obtained. Many of the roosting fields in this farm were in the process of being harvested, and the disturbance created by the cutting operations caused all the several species in the area to concentrate together in the shrinking stands. Thus in one field where some trial netting was done at sunset, there were flighting in to roost in company several hundred roseringed parakeets, and equal quantities of common mynas, house crows, and rosy pastors. Even before the operation could commence the nets got sagging full with dozens of unwanted parakeets and mynas. Extricating an angry parakeet from a mist net in falling dusk is not an amusing experience, and it soon became clear that netting for pastors at such mixed roosts is an impracticable and unprofitable proposition. Somewhat earlier in the season rosy pastors are said to occupy separate roosts of their own species. Only then would their netting seem feasible. A further investigation will be made next season at a more appropriate period. Rosy Pastors should prove a rewarding subject for investigation both from the migration and the arbor-virus dissemination points of view.

WAGTAIL ROOSTS NEAR CALCUTTA

Mr. P. V. George, the discoverer of the Kerala Wagtail roosts, who is currently in Calcutta, reported in January having located very large roosts of wagtails and swallows in the Salt Lake area on the outskirts of that City. Netting and ringing could not be organized this season for lack of rings and the required personnel. But these are very welcome finds, and it is hoped to exploit the possibilities of the roosts in the coming autumn and winter, and to enlist and train local volunteers for operating a regular field station in this area.

Field Guide to the Amphibians of Western India

PART 1

BY

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(*With two plates and fourteen text-figures*)

The study of Indian amphibians has not equalled the progress made in recent years in other vertebrate groups. Though the majority of Indian species are now known, the information available on their mode of life and life-history is meagre. A handicap to the student of Indian amphibians is the lack of comprehensive and easily available literature. The FAUNA OF BRITISH INDIA volume on the group was published in 1890, and subsequent papers are scattered over several journals. In these circumstances, it was felt that even the consideration of the status of species occurring within a limited area would be of value to create interest in a very neglected field of study.

Two regions in India have a very rich amphibian fauna, the Western Ghats and the eastern Himalayas. This paper describes the amphibians of the Western Ghats with special reference to species found in the plains and hill areas of Salsette Island and Bombay City and the ghats or hilly areas to the south-east of the City. Most of the common species occurring elsewhere in India are represented here, as well as some genera which are peculiar to the Western Ghats, like *Nyctibatrachus*. The species occurring elsewhere along the length of the Western Ghats are also described including those which I have not observed personally.

I am indebted to Mr. Humayun Abdulali for having interested me in the study of amphibians and for having given me the opportunity of accompanying him on field trips over several years.

These notes include a brief sketch of the natural history of amphibians; characters of external morphology aiding their specific identification; keys for the separation of families, genera, and species occurring in the area of study; and a description of the species. For the sake of completeness information already available has been compiled.

The amphibians consist of three well-defined types, grouped in three Orders:

Caudata : tailed salamanders and newts, represented by a single species in the eastern Himalayas;

Gymnophiona : limbless, snake-like amphibians, represented by five genera and 14 species;

Salientia : quadruped frogs and toads represented by five families, 18 genera, and 111[1] species.

These Orders have certain characters in common. They are cold-blooded vertebrates having a smooth or rough glandular skin and lacking fur, feather, and/or scales found in dry-skinned, truly land vertebrates. A primitive type of scale occurs embedded in the skin of some caecilians.

The skin of the amphibians has several functions. The numerous glands on the skin keep it moist with their secretion; however, this offers little protection against dessication and consequent death. The frogs and caecilians therefore keep to a moist humid habitat. The toads are comparatively better protected and are able to survive in areas unsuitable for frogs but even a toad restricts its wandering for food to the humid night and seeks a cool retreat in which to spend the hours of daylight. The moist skin also acts as a temperature regulator keeping the body cooler than the surrounding air in dry air and warmer in humid air. Frogs are thus better able to function on a rainy than on a sunlit day. Another effect of this function is noticed in the habitat preference of tree frogs. Small tree frogs which have a large surface area in relation to body weight would lose a larger volume of water through evaporation. They are consequently unable to occupy higher levels of trees where wind promotes a rapid rate of evaporation and are, therefore, usually seen on bushes and lower levels of trees.

The skin glands also protect the animal. They are usually found grouped together as the parotoids in toads, or are seen in ridges as in many species of *Rana*. Their secretion, produced on being provoked, is injurious to the mucus membrane of the eye and mouth of other animals. The action of the poison is said to resemble that of digitalis.

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[1] This figure does not include the 19 species described by C. R. N. Rao in 1937 in the *Proc. Ind. Acad. Sc.* as the type specimens are not now available. The total number of valid species awaits a revision of the Order.

The skin acts as a respiratory organ as well, and the cool wet crannies along stream and pond banks in which frogs hide provide an ideal situation for this function. In addition the skin has a chemical sense which enables amphibians to avoid areas unsuitable for them in their habitat and is also sensitive to light helping the animals to avoid bright sunlight.

Most of the Indian species are sober-coloured, with various shades of brown and grey predominating. Red, which is an uncommon colour in amphibians, is seen in many Indian species. *Microhyla rubra* and *Rana malabarica* have shades of red on the back as a major component of their colour pattern. The common toad (*Bufo melanostictus*) has often a pale red ground colour. Red spots and patches are seen in *Rana rufescens*, juvenile *Rana limnocharis*, and the Microhylid *Kaloula pulchra taprobanica*. The inside of the thighs is bright red during the breeding season in such unrelated species as *Megophrys parva*, and *Philautus annandalii* of the eastern Himalayas, and *Rana beddomii* and *Micrixalus fuscus* of the Western Ghats. The large wrinkled frog *Nyctibatrachus major* is often dull reddish orange, and some specimens of Humayun's Wrinkled Frog *Nyctibatrachus humayuni* almost purplish. The bi-coloured frog *Rana curtipes* has an unusual colour pattern being grey above and black below. Most frogs and toads have the ability to change colour to a certain extent. This character is developed to a remarkable degree in the tree frogs. The Chunam Frog *Rhacophorus maculatus* can change from green to darker shades, and from brown to pale creamish yellow. Low temperature and high humidity tend to darken, and high temperature and dryness to lighten colours. One curious factor in amphibian coloration is the limitation of pattern types seen in the group as a whole. A dark band between the eyes for example appears in several Indian species.

The eye of amphibians is adapted for far sight. The iris is beautifully coloured in many species being often flecked with gold. In the terrestrial frogs and toads and the arboreal tree frogs the eyes are of a large size and placed well above the plane of the head. The burrowing species usually have small beady eyes, and in many caecilians the eye has degenerated and may not be visible above the skin. Frogs and toads have good colour vision and show a preference for green and blue, believed to be in association with their habit of hunting in grass.

The sense of hearing is particularly well developed in most amphibians. The tympanum, which is exposed on the side of the head, is usually circular or oval in shape, and in size equal to or less than the diameter of the eye. It is not visible externally in many species and may be completely absent along with the middle ear in burrowing forms; however, these are quite receptive to the call of their kind during the breeding season. Hearing also plays a part in the detection of prey. Toads can spot the location of an insect on hearing its call.

The sense of smell, not well developed in adult frogs and toads, is believed to be acute in tadpoles. The burrowing caecilians are peculiar in having tentacles which are connected with the nasal passages and act as tactile noses for conveying smell impressions. Frogs and toads are indiscriminate feeders and have a poorly developed sense of taste but obnoxious material is either left untouched, or voided if taken. The former may be learnt from experience, while the voidance is helped by the ability of some species to evert their stomach when anything disagreeable is swallowed.

The most remarkable factor in the life of amphibians is their breeding habit. It is a well-known fact that, among land vertebrates, only amphibians begin their lives in water as tadpoles. It is during the breeding season, coinciding with the monsoons in India, that the normally circumspect frogs and toads throw all caution to the winds and the male makes its presence known by its loud call, a sound which, at night in well-watered country, is a continuous roar as thousands of frogs and toads of different species give tongue to advertise their presence in the selected breeding site.

The larynx in the male is divided by the vocal organ in the form of a thickened lip and sound is produced by the vibration of the rim of this lip as air from the lungs is forced into the vocal sacs, which act as resonators amplifying the volume of sound. The lungs and vocal sacs act as a closed system, air being forced back and forth between the two. The call at the breeding season is one of the principal means of guidance for individuals of a species to gather at suitable breeding sites. The noise made by early arrivals guides the late comers. The sense of hearing is acute at this period and experiments have proved that some species can recognise the call of their kind at distances of over 600 yards. The call of each species is distinctive and is a good guide for field identification. Normally the depth of tone is in proportion to the size of the frog, the larger species having a deeper voice, but exceptions occur. Abdulali (1962, *J. Bombay nat. Hist. Soc.* **59** : 236) records the call of *Kaloula pulchra taprobanica* as being shriller than that of the smaller *Ramanella montana*. Several other factors, e.g. condition of the gonads, increased humidity, temperature of the water, moisture gradient, and odour of aquatic vegetation, influence the arrival of the animals at their breeding grounds. The breeding site is usually a place of clamour and activity with scrambling for position among the males. The normal method of amplexus is for the male to clasp the female with his forelegs around the body behind her forelegs. The male is carried round till the eggs are laid and fertilised. Several factors help the male to recognise the female. Most males embrace any object in movement similar to them or slightly larger in size, but if the embraced object does not have certain characters it is released. These characters are the correct size and firmness, gravid females having distended, tense abdomens. A male, when embraced by another, croaks while females are silent. The breathing movement of the female also stimulates the grasp reflex of the male. Males in amplexus kick vigorously to resist attempts by other males to dislodge them. Several species may breed in the same area but the characters that help reproductive isolation are not fully known. Many frogs and toads emit an odour which is sometimes pungent, but there may also be odours beyond human comprehension which may be of significance in sex and species identity. In two Indian species, this character has been noticed. In *Rana malabarica*, McCann (1946)[1] records an odour similar to that of fungus, and I have noticed an odour akin to that of vulcanised rubber in *Rana curtipes*. In both species the smell was noticed during the breeding season at the onset of the monsoon.

Secondary sexual characters are developed by the males of many species during the breeding season. Spines and callosities are often present on the fingers. As mentioned earlier many have the inside of the thighs bright red. The throat of the male, if the vocal sac is internal, may be black in colour in association with the capacity for enormous expansion of the region during the breeding season. In *Rana beddomii* a granular patch is seen on the inside of the thigh.

The manner of deposition of the eggs varies, many frogs lay them in a frothy mass. Among the tree frogs the eggs are usually not laid in water, but in a situation which would enable the developing young to be released into water. The egg mass hardens into a crust on the outside in these species. The toads lay their eggs in gelatinous strings of varying lengths which are loosely twined round water-weeds by the movements of the female. The number of eggs laid by one female may be as high as 2000+ in Indian species; those which have an abbreviated larval life lay a smaller number varying with the period of the larval life. Eggs, larvae, and breeding habits of many species of Indian amphibia are yet to be described. The tadpoles usually have numerous teeth rows in the mouth area. The number of teeth rows varies in different species and is one of the characters used for identification. The teeth are absent in some species and tadpoles of species breeding in torrential streams often have a circular ventral sucker.

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[1] McCann, C. (1946) : Strong odour emitted by the fungoid frog *Rana malabarica*. *J. Bombay nat. Hist. Soc.* **46** : 406.

Amphibians are relatively defenceless animals and seek safety in crevices and other shelters when faced with danger or remain immobile depending on their cryptic coloration to escape detection. The skin secretions also give a certain amount of protection, but many predators are immune to their effect. The common toad (*Bufo melanostictus*), for example, is a normal item of food of the Green Keelback (*Macropisthodon plumbicolor*). A method of defence, used mainly by toads, is to inflate the body thus making it difficult for the predator to hold the smooth and swollen body. This reaction is activated by the size and speed of the approaching object. An object the size of a snake's head evokes it, while the approach of a larger body is ignored.

Amphibians are beautifully adapted to life in their particular environment and usually it is possible to 'place' a species by a superficial examination, for instance burrowing species have well-developed metatarsal tubercles, the spades they use for digging, while tree frogs have large adhesive discs, and aquatic species have extensive webbing on the toes.

The bulk of the food consumed by amphibians consists of invertebrates, mainly insects. They also feed on any animal, including others of their kind, which they can overcome.

KEY CHARACTERS OF EXTERNAL MORPHOLOGY

The identification of amphibians, particularly the frogs and toads, to even the family level could be difficult to non-herpetologists as there are no marked differences in their external appearance. There are, however, several characters of the external morphology by which the animals can be separated down to the species in the field. These characters are:

1. The skin: As a rule, the appearance of the skin is moist in frogs, and dry and rough with numerous spiny tubercles and warts

in the toads. Tubercles which may be present in frogs are not as prominent as in the toads.

Skin glands are numerous and may occur as a localized mass, as the characteristic Parotoid Glands (Text-fig. 1, *a*) which occur behind the eyes and above the tympanum in almost all toads. The glands also occur as folds or ridges on the skin, the most frequent being a pair of dorso-lateral folds along the flanks (Text-fig. 2, *dl*), supratympanic (Text-fig. 3, *st*) from behind the eye to the shoulder, and longitudinal folds of different lengths, parallel to each other or otherwise, on the back (Text-fig. 4). The numerous ridges on the back sometimes give a wrinkled appearance to the skin as in *Nyctibatrachus*.

In some species a row of porous warts analogous to the lateral line organs in fishes are found from near the groin up to the axilla (Text-fig. 5, *pw*). Ventrally the skin is usually smooth but may have varying degrees of granulation on the belly and inside of the thighs particularly in arboreal species. Bony ridges occur on the head of some toads (Text-fig. 1, *b*). In the breeding season the males of many species develop spines and callosities on the hands and sometimes glandular or granular patches on the thighs and breast.

2. The head: The shape and the relative dimensions of parts of the head help in identification. These are: the length of the head in relation to its width, the shape of the pupil, vertical, horizontal, or circular (Text-fig. 6); inter-orbital width or the space separating the eyes in comparison to the width of the upper eyelid (Text-fig. 1, *d*), the diameter of the tympanum, if visible, in relation to the horizontal diameter of the eye and its distance from the eye; the distance of the nostril from the eye and the tip of the snout; the shape of the snout and the nature of the canthus rostralis or the angle of the junction of the side and top of the snout (Text-fig. 1, *c*).

3. The mouth: The width of the mouth is usually equal to the maximum width of the head. The tongue is attached to the front of the mouth and free behind. It varies in shape being bifid at the end (Text-fig. 7, *b*, *c*) or entire, oval (Text-fig. 7, *a*), pyriform (Text-fig. 7, *d*), or terminating in a point. A pointed papilla is seen in the middle of the tongue in some species (Text-fig. 7, *b*). The lower jaw is toothless in Indian species and the upper jaw may or may not have teeth. These teeth are minute and difficult to distinguish but can be made out by passing a finger or a needle over the jaw (Text-fig. 8). In addition to these, some genera have two rows of teeth on the inside of the mouth close to the internal opening of the nostrils (Text-

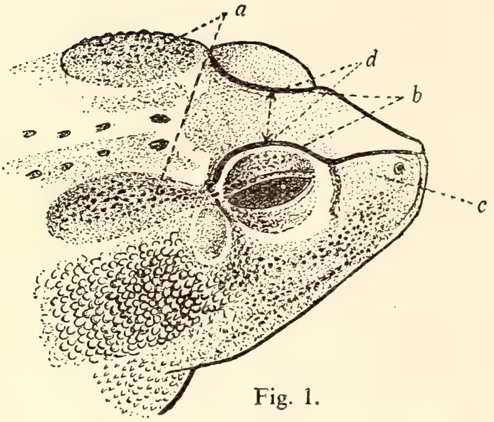

Fig. 1.

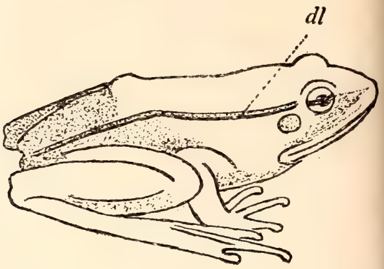

Fig. 2.

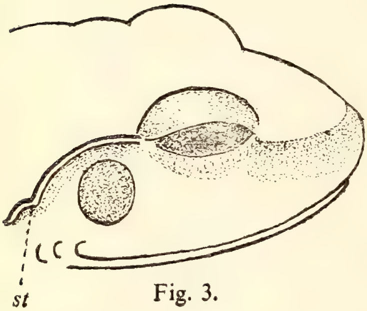

Fig. 3.

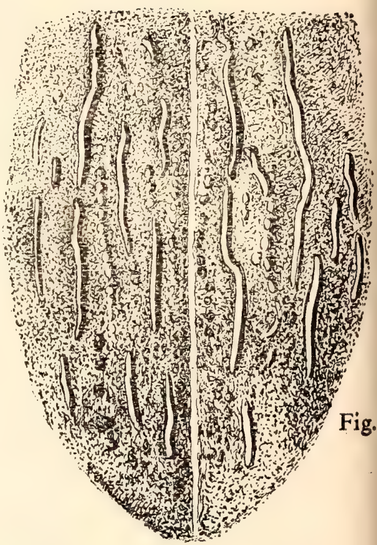

Fig. 4

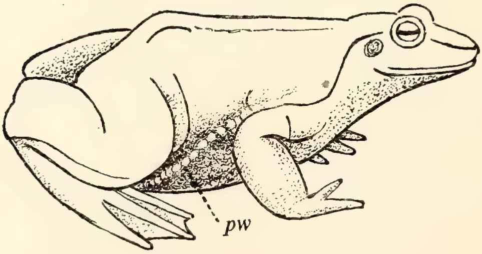

Fig. 5.

Fig. 1. (*a*) Parotoid glands, (*b*) Cornified ridges, (*c*) Canthus rostralis, (*d*) Inter-orbital width ; Fig. 2. Dorso-lateral fold ; Fig. 3. Supra-tympanic fold ; Fig. 4. Longitudinal folds ; Fig. 5. Porous warts

(Figures diagrammatic)

fig. 9, *v*). These are the vomerine teeth and their form and position are also useful for identification.

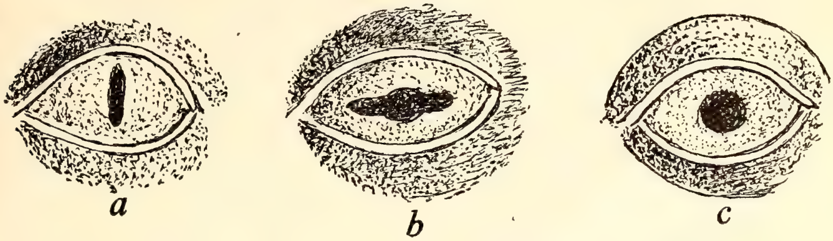

Fig. 6. Shape of the pupil : *a.* vertical, *b.* horizontal, *c.* circular
(Figures diagrammatic)

4. The limbs: The forelimbs are always considerably shorter than the hindlimbs in frogs and toads. The hand has four digits the first digit being the one nearest the body. The hindlimbs are very long, particularly so in the frogs and consist of the femur, tibia, tarsus, and foot (Text-fig. 10). The foot has five toes.

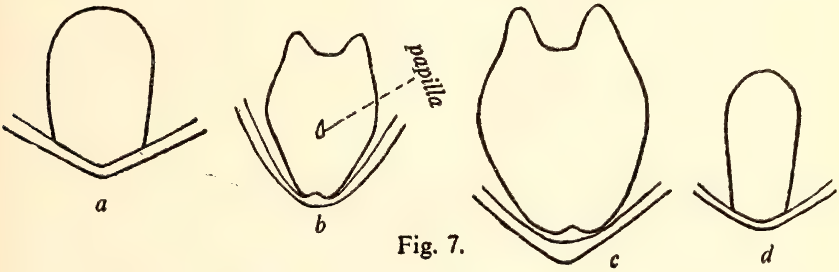

Fig. 7.

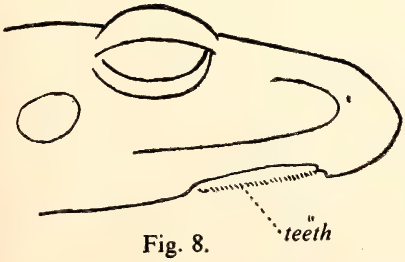

Fig. 8.

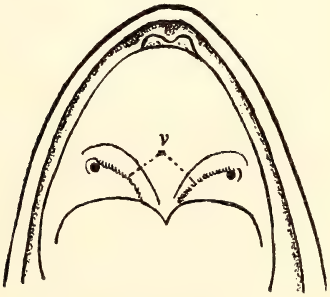

Fig. 9.

Fig. 7. Shape of tongue : *a.* oval, *b.* & *c.* bifid, *d.* pyriform ; Fig. 8. Upper jaw showing row of teeth ; Fig. 9. Palate region showing vomerine teeth (*v*)
(Figures diagrammatic)

The characters of the limbs used in diagnosis are:

(i) The relative lengths of the 1st and 2nd finger.

(ii) The point reached by the tibio-tarsal articulation (tarso-metatarsal in toads) when the hindlimb is held along the body (Text-fig. 10, *tta*). It may reach the shoulder, the tympanum, the eye, the nostril, the tip of the snout or beyond. The tibio-tarsal articulation is analogous to the human ankle.

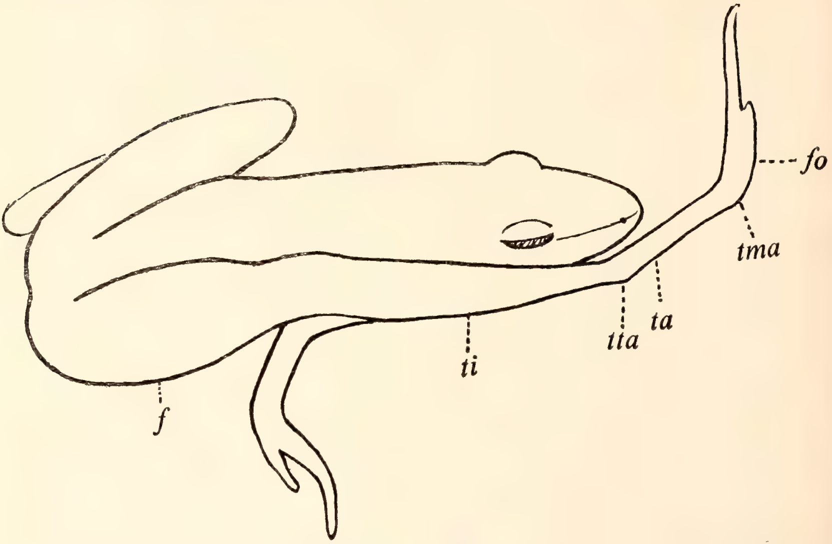

Fig. 10. Parts of the leg: *f.* femur, *ti.* tibia, *ta.* tarsus, *tta.* tibio-tarsal articulation, *tma.* tarso-metatarsal articulation, *fo.* foot

(Figure diagrammatic)

(iii) The feet may or may not overlap when the hindlimbs are folded at right angles to the body (Text-fig. 11, *a*, *b*).

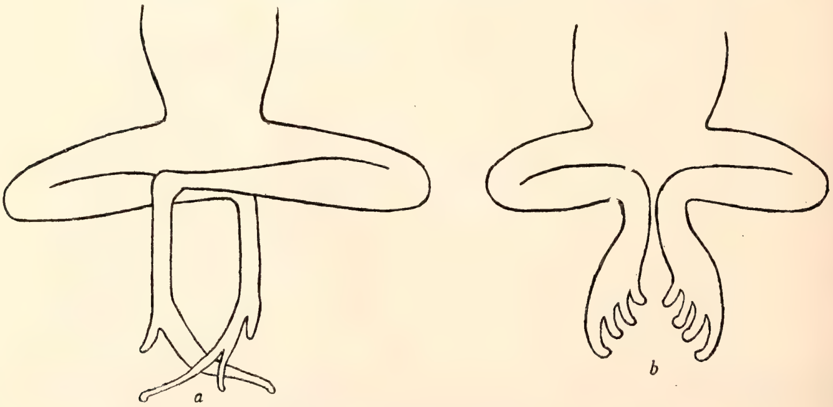

Fig. 11. Position of feet when folded at right angles

(Diagrammatic)

(iv) The two external metatarsals may be entirely separated by web (Text-fig. 12, *oms*) or attached partly or fully (Text-fig. 12, *omb*). A human analogy would be the separation of the little toe from its neighbour by web up to the ankle.

(v) Tubercles, Sub-articular Tubercles: These are found at the joints of the fingers and toes (Text-fig. 12, *sat*). They may be well developed or weak or absent.

Metatarsal Tubercles: Two tubercles occur on the heel of the foot (Text-fig. 12, *imt, omt*), the inner metatarsal tubercle constantly and the outer metatarsal tubercle occasionally. The inner tubercle varies in size and shape and is very prominent and crescentic in burrowing species (Text-fig. 12, *f*).

(vi) Webbing: The degree of webbing of the fingers and toes is of importance. The digits may be $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, or fully webbed or the webbing may be rudimentary or absent (Text-fig. 12, *c, f, d, g, e, a, b* respectively). In many aquatic species the web extends as a fringe along the outer toe up to the tarsus (Text-fig. 12, *fr*).

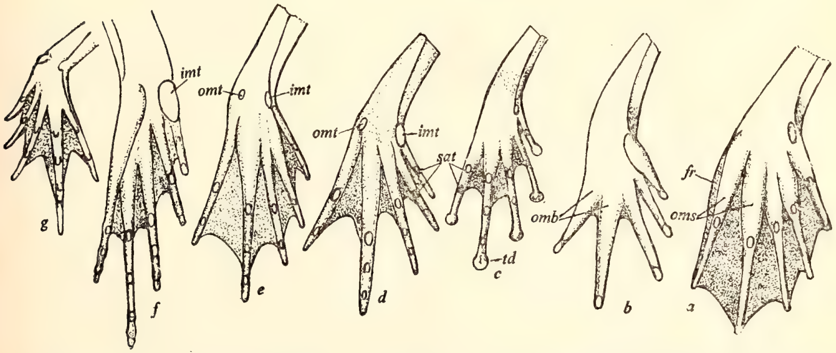

Fig. 12. Foot characteristics : *fr.* fringe, *oms.* outer metatarsals separated by web, *omb.* outer metatarsals bound, *sat.* sub-articular tubercles, *imt.* inner metatarsal tubercle, *omt.* outer metatarsal tubercle, *td.* toe disc

(vii) Finger and toe discs: The tips of the digits are usually obtuse, but in the tree frogs and several torrent-dwelling species, the tip is enlarged into a circular adhesive disc. The tree frogs (Rhacophoridae) also have an additional cartilaginous phalange between the two distal phalanges

(Text-fig. 13, *a*) which gives a characteristic bend to the digits. In many torrent-dwelling Ranidae a circum-marginal groove is found along the side of the disc (Text-fig. 14, c*m*).

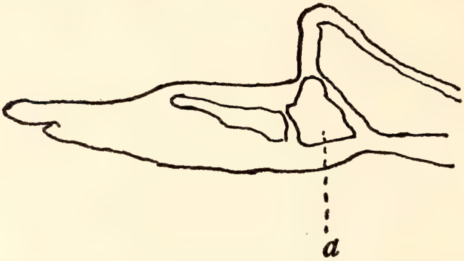

Fig. 13. Toe of tree frog showing additional cartilaginous phalange (*a*) (Diagrammatic)

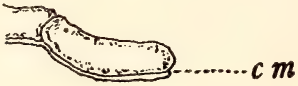

Fig. 14. Circum-marginal groove (Diagrammatic)

KEY TO THE FAMILIES OF AMPHIBIANS OF WESTERN INDIA

1.	Limbs absent ; body snake-like ..	Caecilidae
	Limbs present ; without tail in adult ..	2
2.	Upper jaw toothed, tongue bifid[1] (Text-fig. 7, *b* & *c*, and 8) ..	3
	Jaws toothless, tongue entire (Text-fig. 7, *a* & *d*) ..	4
3.	Digits with an intercalary cartilage between penultimate phalanges (Text-fig. 13, *a*) ..	Rhacophoridae
	Digits without intercalary cartilage ..	Ranidae
4.	Pupil horizontal (Text-fig. 6,*b*), tongue pyriform (Text-fig. 7, *d*), skin tubercular ..	Bufonidae
	Pupil circular (Text-fig. 6,*c*), tongue oval (Text-fig. 7, *a*), skin smooth ..	Microhylidae

Family CAECILIDAE : Caecilians

Fossorial, limbless amphibians, snake-like in general appearance, for which they are often mistaken. The head, except for the lack of annulations, is not distinguished from the body. The eyes may or may not be visible externally. There is a short tentacle on each side of the head between the eye and the nostril. The mouth is armed with teeth. The body has a series of annulations. A short tail may be present or absent. The caecilidae are the most primitive among the amphibians and are found only in the tropical regions of Asia, Africa, and America. Very little is known of these secretive creatures.

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[1] Except in the genus *Ooeidozyga* of Ranidae, which genus does not occur in W. India.

Five genera occur in the Indian region and of these *Herpele* is restricted to eastern India, *Gegeneophis,* and *Uraeotyphlus* to south-western India, and *Indotyphlus* is known only from the type locality, Khandala and the neighbourhood of Lonavla in the Western Ghats, 75 miles south-east of Bombay City. The genus *Ichthyophis* is widely distributed being found all along the Western Ghats from the Dangs southwards and also in some areas of the Eastern Ghats and north-east India. Its extralimital distribution extends to the Philippines. It is likely that *Ichthyophis* as well as other genera may occur in suitable areas in other parts of the country, particularly the hills of central India. Their distribution is, however, restricted to areas with good rainfall.

A key to the Indian genera of the family as well as to the species of Indian *Ichthyophis* has appeared in a recent issue of the *Journal* [Taylor, 1961, 'Notes on Indian Caecilians', *Vol.* **58** (2) : 355-365]. Of the other three genera, which occur in south-west India, *Indotyphlus* and *Gegeneophis* are monotypic; therefore, only a key to species of *Uraeotyphlus* is included here.

Genus **Indotyphlus** Taylor 1960

Indotyphlus battersbyi Taylor 1960

Diagnosis. A slender caecilian, uniform light brown in colour, distinguished by its transverse anus and absence of tail.

Habits. During the rains (June to September) the animal lives under stones on the grassy hill-sides at Khandala. It has not been collected at any other season. In its slender girth and colour it bears a striking resemblance to the earthworm which occurs with it in its habitat, but the caecilian can be distinguished by its distinctive head.

Breeding habits and larvae unknown.

Genus **Gegeneophis** Peters 1879

Gegeneophis carnosus (Beddome) 1870

Diagnosis. A slender species similar in dimensions to *Indotyphlus* which it also resembles in its uniform flesh colour. However, the head is yellowish in colour and the eyes are not visible. Tentacle globular surrounded by a circular groove and situated behind and below the nostril.

Distribution and habits. Originally collected under stones at Peria Peak in the Wynaad, Malabar. The species has also been reported further south in Kerala from Kallar (500 ft.) at the foot of the Ponmudi Hills (Ferguson 1904)[1], Tenmalai and Trifandru at sea-level (Seshachar 1942)[2]. The species thus has a considerable altitudinal range and its distribution is perhaps influenced only by climatic conditions.

Breeding habits. A large number of adults with their eggs were taken from burrows by the side of small hill streams at Tenmalai, Kerala, by Seshachar (1942) who records that the egg clusters of about 15 eggs each resembled *Ichthyophis* eggs but with the difference that in this species the filaments connecting the eggs were not twisted together as in *Ichthyophis*, and also in the embryos having only two well-developed gills, the third being rudimentary or absent.

Genus **Uraeotyphlus** Peters 1879

Diagnosis. Distinguished from *Indotyphlus* and *Ichthyophis* by the tentacle being closer to the tip of the snout than to the eye and from *Gegeneophis* by the presence of eyes.

KEY TO THE SPECIES OF *URAEOTYPHLUS* PETERS 1879

150-177	folds or annulations round the body	..	*narayani*
195-197	,, ,,	..	*menoni*
200-210	,, ,,	..	*oxyurus*
240-260	,, ,,	..	*malabaricus*

Colour in life size

Uraeotyphlus narayani B. R. Seshachar 1939: Steel grey, ventrally pale flesh-coloured except on the throat and also posteriorly where it is dark. A pale spot round the vent.

Uraeotyphlus menoni N. Annandale 1913: Slate grey above, paler on lips and throat; ventrally white blotched with slate grey. A pale spot round the vent.

Uraeotyphlus oxyurus (Dum. & Bibr.) 1854: Blackish or purplish brown, lighter sometimes, white beneath lip and on folds on side. Length 11 inches, diameter 0.5 in.

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[1] Ferguson, H. S. (1904) : A list of Travancore Batrachians. *J. Bombay nat. Hist. Soc.* **15** : 499.

[2] Seshachar, B.R. (1942) : The eggs and embryos of *Gegeneophis carnosus* Bedd. *Curr. Sci.* **11** : 439.

Uraeotyphlus malabaricus (Beddome) 1870: Dark olive-brown above, slightly paler below. Lips and tip of snout yellowish. Length 9 in., diameter 0.3 in.

Very little information is available on these animals. *U. oxyurus* is perhaps the commonest species. The type locality of *U. oxyurus* and *U. malabaricus* is given as 'Hills of Malabar', but several specimens of the former are recorded from Cochin which is also the type locality of *U. menoni*. This species has also been collected at Koduvalli, 13 miles north of Calicut [Elayidom *et al.*, 1963, *Curr. Sci.* **32** (6) : 274]. The type locality of *U. narayani* is Kannam, 16 miles from Kottayam, Kerala.

Breeding habits and larvae are unknown.

Genus **Ichthyophis** Fitzinger 1826

Six species occur in western and south-western India. These are:

(i) *Ichthyophis bombayensis:* Surat Dangs (Waghai).

(ii) *I. subterrestris:* Alibag, Kolaba District. (across the harbour from Bombay City); Anamalai Hills, Kottayam, Kerala.

(iii) *I. beddomii:* Gersoppa, N. Kanara; Nilgiris; Kerala.

(iv) *I. peninsularis:* Malabar, Kerala.

(v) *I. tricolor:* Nilgiris; Peermade, Kerala (T. L. Maddathori).

(vi) *I. malabaricus:* Maduvangard, Kerala.

The seven species (including *I. sikkimensis* of the eastern Himalayas) of Indian *Ichthyophis* described by Taylor were formerly grouped under *I. glutinosus* and *I. monochrous*, and the available information on their habits perhaps refers to one or the other of several species. However, as the Ichthyophids have very similar habits, the notes given below can be considered as typical for the genus.

These caecilians are not uncommon in well-watered country, particularly in the hill areas and are also the most well known among Indian Gymnophiona. According to Seshachar *et al.* (1932)[1], specimens have been collected from under rocks, fallen tree trunks, decaying vegetation, dilapidated houses, and under hayricks. They have limited burrowing capacity useful only in soft moist earth, and in dry months live under stones and rotten wood. On moist ground they can move quickly and are difficult to capture. Abdulali (1954)[2] records the movement of *I. beddomii* 'as a series of ripples reminiscent of a millipede rather than a snake or eel'. They swim well with horizontal movements like a snake but are uncomfortable in water. Under provocation the skin exudes a cream-coloured secretion with the smell of musk. While moving the tentacles are constantly protruded and retracted. They are essentially solitary animals.

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[1] Seshachar, B. R., & Muthuswamy Iyer, M. S. (1932) : The Gymnophiona of Mysore. *Half Yearly Journal, University of Mysore* (6) : 170.

[2] Abdulali, H. (1954) : Distribution and habits of the Batrachian *Ichthyophis glutinosus* Linn. *J. Bombay nat. Hist. Soc.* **52** : 639.

Their main food appears to be earthworms (Wall 1922)[1], but they are also known to take termites and small earthsnakes.

Breeding. The main period is between March and September. The eggs are few in number and large-sized, about 10 mm. in diameter. Each egg has a filament and the filaments of a clutch are twisted together. The mother after laying the eggs in a burrow near water, coils around them and gives a certain amount of protection during development. The caecilians provide the only instance of parental care among Indian amphibians. The larvae are found in small hill streams.

Family BUFONIDAE: Toads

Nine species grouped under three genera are recorded from Western India.

KEY TO THE GENERA OF BUFONIDAE

1.	Parotoid glands absent (Plate I, fig. 1)	.. *Ansonia*
	Parotoid glands present (Text-fig. 1, *a*)	2
2.	Fingers webbed, discs present (Plate I, fig. 4, *a*)	.. *Nectophryne*
	Fingers free, no discs (Plate II, fig. 1)	.. *Bufo*

Genus **Ansonia** Stoliczka 1870 : Torrent Toads

The generic characters are: Head without cranial ridges; parotoid glands absent; skin with small tubercles, finger and toe tips swollen; toes fully webbed; eggs unpigmented, large-sized (2+ mm. diameter as compared to 1+ mm. in *Bufo*); less than 250 per clutch (1000+ in *Bufo*). Tadpoles which are found in hill-streams have a large sucker-like oral disc (Inger 1954)[2].

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[1] Wall, F. (1922) : Report on some lizards, frogs and human beings in the Nilgiri Hills. *J. Bombay nat. Hist. Soc.* **28** : 493.

[2] Inger, R. F. (1954) : Systematics and Zoogeography of Philippine Amphibia. *Fieldiana, Zool.,* **33** (4) : 239.

Ansonia ornata Günther 1875 : Malabar Torrent Toad

Bufo pulcher Boulenger 1882.

(Plate I, Fig. 1, 2)

Diagnosis. A small (30 mm. head to vent length) slender toad with distinct tympanum, half the diameter of the eye. Parotoids absent. First finger shorter than second; toes almost fully webbed; tibio-tarsal articulation reaches to between eye and tip of snout; skin of back finely granular on anterior half only.

Colour. Black with greyish head or with greyish spots on head and a grey dorsal line; ventrally black with bright yellow spots.

Distribution. This species has been recorded only from the Brahmagiri Hills in Coorg, Mysore State.

Breeding habits and larvae unknown.

Allied species which occur in Malaya and the Philippines live in and near the hill streams where they breed. The tadpoles with their sucker-like mouth discs are adapted for life in hill torrents.

Genus **Nectophryne** Buchholz & Peters 1875 : Tree Toad

Nectophryne tuberculosa (Günther) 1875 : Malabar Tree Toad

(Plate I, Fig. 3, 4)

Diagnosis. A slender, small (35 mm. head to vent length) toad with the tips of fingers and toes dilated into truncated discs. Tympanum distinct, $\frac{1}{3}$ diameter of eye. Parotoids present. Fingers webbed at base; first finger half the length of the second. Toes almost fully webbed. Skin of back tubercular with the largest tubercles in two rows on the sides of back. Colour brownish grey above with darker sides. A white band from below the eye to the shoulder and another on the flank. Below whitish spotted with black.

Distribution. Malabar.

Habits and larvae unknown. An allied species in Malaya *N. hosii* has been observed on bushes and small trees near water during the breeding season. The eggs of the Malayan species are laid in strings.

Several species of the genus occur in Africa and south-east Asia. Two are known from India, *N. tuberculosa* and *N. kempi* Boulenger 1919 from Garo Hills, Assam, which has the tympanum hidden.

Genus **Bufo** Laurenti 1768 : Toads

Toads are easily recognised by their warty skin and the presence of two well-marked glands behind the head, the parotoid glands. They are true land animals and except for the breeding season are not seen in water. They have a world wide distribution but are not found in areas where the ground is permanently frozen and are also absent in Australasia, and in some oceanic islands.

Seven species occur in western and south-western India.

KEY TO THE SPECIES OF *BUFO* LAURENTI 1768

1. Head without bony ridges (Plate II, fig. 5) .. 2
Head with bony ridges (Plate II, fig. 1) .. 3
2. Tympanum nearly as large as eye, toes webbed at base (Plate I, fig. 5) .. *hololius*
Tympanum ⅔ diameter of eye, toes ⅔ or ½ webbed (Plate II, fig. 5) .. *stomaticus*
Tympanum very small or indistinct, toes fully webbed .. *beddomii*
3. Parietal ridges present (Plate II, fig. 7*a*) .. 4
Parietal ridges absent (Plate II, fig. 1) .. 5
4. Size large ; first finger longer than second .. *parietalis*
Size small ; first finger equal to second .. *fergusonii*
5. Tympanum ⅔ diameter of eye (Plate II, fig. 1) .. *melanostictus*
Tympanum small less than ½ diameter of eye (Plate II, fig. 4) .. *microtympanum*

Bufo hololius Günther 1875

(Plate I, Fig. 5)

Diagnosis. A small toad, 38 mm. in snout to vent length, without cranial ridges. Distinguished by its large tympanum nearly as large as the eye and slightly webbed toes. First finger slightly longer than second.

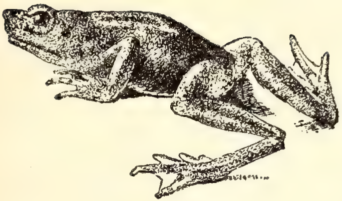
Skin with flat glandular patches. Colour olive-brown above marbled with brown, immaculate white below.

This species is uncommon. It has been reported from Malabar, Kerala. Habits and larvae are not known.

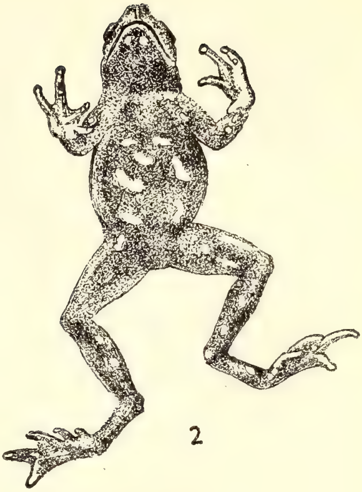
Bufo beddomii Günther 1875 : Beddome's Toad

Diagnosis. A small toad 41 mm. in head to vent length, distinguished by its very small rather indistinct tympanum and entirely webbed toes. First finger equal to or less than the second in length.

Skin tubercular, brown above with indistinct black spots, limbs marbled with carmine and ventrally marbled with brown.



1



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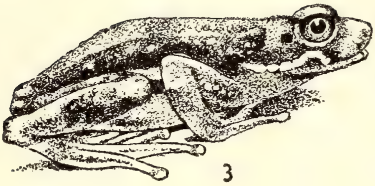

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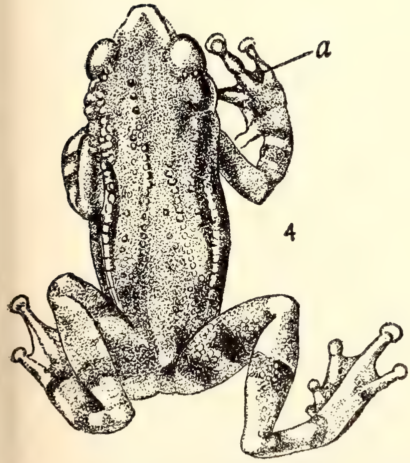

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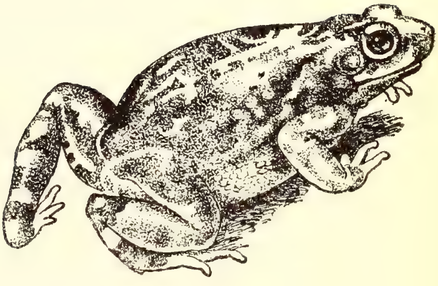

5

1 and 2. *Ansonia ornata*; 3 and 4. *Nectophryne tuberculosa*; 5. *Bufo hololius*
(Sketches after Günther, 1875)

(Magnification of all figures : × *c.* 1½)

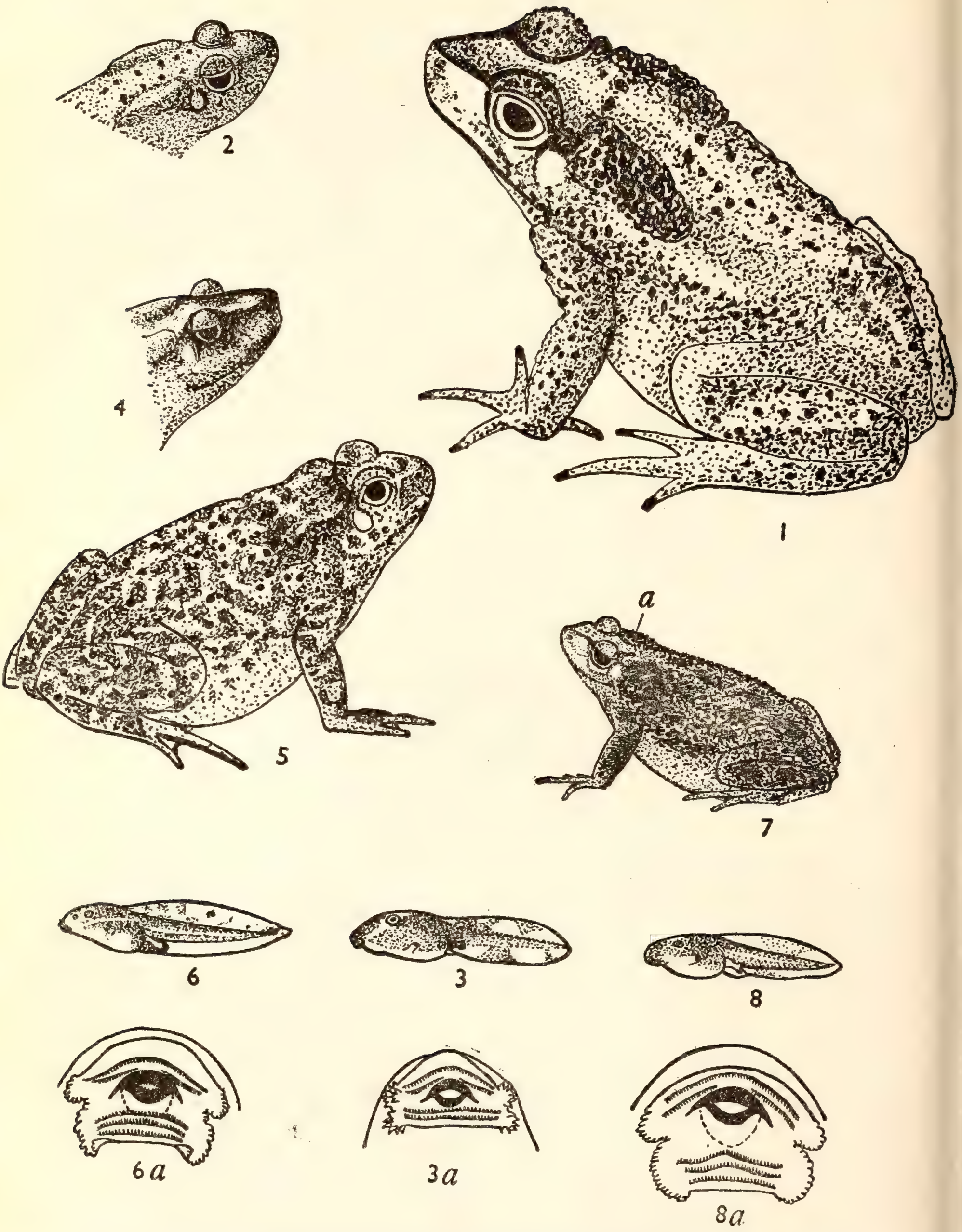

Fig. 1, 2, and 3. *Bufo melanostictus* ; 4. *Bufo microtympanum* ; 5, 6, and 6a *Bufo stomaticus* ; 7, 8, and 8a, *Bufo fergusonii*

NOTE : Fig. 2 : ×3 ; rest ×1, except 3, 6, and 8 : × *c.* 2½ ; 3*a*, 6*a*, and 8*a* : Mouth parts of tadpoles (diagrammatic). Colour in life : 3 : uniform black ; 6 : black with silver spots ; 8 : dark brown

A rare toad recorded from the Travancore Hills, Kerala, between 2500 ft. (where Beddome collected a specimen under an old rotten log in dense forest) and 4500 ft.

Bufo stomaticus Lutken 1862: Marbled Toad

(Plate II, Fig. 5, 6, 6 *a*)

Diagnosis. Medium-sized (76 mm. in head to vent length when adult). Tympanum distinct, $\frac{2}{3}$ diameter of eye, vertically oval or circular. First finger longer than the second. Toes about $\frac{2}{3}$ webbed, tarso-metatarsal articulation reaches to between the shoulder and eye. Two equal-sized metatarsal tubercles with sharp edges.

Skin may be smooth with a few flattened tubercles or heavily tuberculated. Crown of head above parotoid glands smooth or with a few scattered tubercles. A row of white tubercles along the outer aspect of the forearm, ventrally coarsely granular but with the chin and throat smooth.

Colour. Grey or olive above, rarely uniform but more often with darker marblings. Ventral side and upper lip white. Juvenile toads are light brown with darker marblings which have a pale pinkish centre. This colour pattern helps to distinguish this species from the dark grey or almost black juvenile *B. melanostictus* of similar age group. The juvenile coloration may be seen in specimens up to 30 mm. in snout to vent length. The male has a bright yellowish tint during the breeding season.

The male has a subgular vocal sac and has black cornified patches on the inner aspects of the first and second fingers during the breeding season.

Breeding. The toads breed in the Bombay area from June after the onset of the monsoon and tadpoles at different stages of development are available up to August. Within the City they have been observed breeding in shallow rainwater pools in the Backbay area, often about a hundred yards from the sea. The call of the male is distinctive and easily distinguished from that of the common toad (*Bufo melanostictus*). The amplexus is axial. The eggs are laid in translucent strings, pale yellowish green in colour. The tadpoles are small. The coloration is distinctive, being black with shiny silvery spots on the body. The metamorphosed young measures less than 10 mm. in snout to vent length.

Distribution. West Pakistan, India (no records from the west coast, except Bombay), Nepal, Ceylon.

Habits. This toad is equally at home under varying climatic conditions but appears to be commoner in dry areas and under semi-desert conditions. It occurs up to 6000 ft. in the Nepal Himalayas and is believed to replace *Bufo melanostictus* above 3000 ft. in the hills of Waziristan. They are nocturnal but during the breeding season can be seen moving around during the day. In areas of scanty rainfall they aestivate during the summer. C.R.N. Rao (1923)[1] records that a specimen was unearthed from 4 ft. underground in Waziristan. In Kutch, McCann (1938)[2] observed these toads visiting a pool to spend some time in it before setting out on their nightly rounds, presumably to replace the water they may have lost during the day. Usually solitary, but if kept together in captivity they have the curious habit of resting all together in a jumbled heap. They burrow easily in wet or sandy soil, using their metatarsal tubercles for the purpose. In captivity they fed on termites but refused larger prey.

Related species. Bufo stomaticus has been confused with *Bufo andersoni*, the Arabian Toad but can be distinguished from it by the absence of a tarsal fold and by the tadpoles being black instead of yellowish. A race was described from Mysore by C. R. N. Rao. Examination of a large series from Bombay proves that the racial characters described by Rao are covered by individual variations.

Bufo parietalis Boulenger 1882

Diagnosis. A medium-sized (85 mm.) toad distinguished by the presence of parietal ridges from other toads of similar size. First finger longer than second. Tympanum $\frac{2}{3}$ diameter of eye, toes half webbed. Parotoids prominent. Colour brown above and marbled with brown on white ventrally.

Distribution. Originally recorded from Malabar. According to Ferguson, the toad is confined to the hills in the Travancore area of Kerala, where it may be seen up to 3000 ft.

Breeding habits and tadpoles not known.

Bufo fergusonii Boulenger 1892 : Ferguson's Toad

(Plate II, Fig. 7, 8, 8 *a*)

Diagnosis. A small toad hardly exceeding 46 mm. when adult. Distinguished from *Bufo parietalis* by its small size, weak cranial ridges, and in the first and second fingers being equal.

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[1] Rao, C.R.N. (1923) : Notes on a collection of Batrachia from S. Waziristan. *J. Bombay nat. Hist. Soc.* **29** (1) : 131.

[2] McCann, C. (1938) : The Reptiles and Amphibia of Cutch State. ibid. 40 (3) ; 427.

Colour olive-brown or reddish with darker markings on the legs.

Distribution. The species was originally recorded from Trivandrum, Kerala. It is now known from North Kerala, Mysore, Madras, and Ceylon.

Breeding. The tadpole of this species has been recorded by Annandale from coastal pools in southern Kerala. They are distinguished from the tadpoles of *B. melanostictus* occurring in the same area by their smaller size, relatively larger nostrils, and brownish instead of black colour.

Habits. According to C. R. N. Rao (1915)[1] this toad is entirely nocturnal and rather rare. It has good capacity for burrowing and specimens kept by him fed exclusively on white ants.

Bufo melanostictus Schneider 1799 : Common Indian Toad

(Plate II, 1, 2, 3, 3 *a*)

Diagnosis. This is the largest among Indian toads reaching a snout to vent length of up to 150 mm. and is only equalled in size by the closely allied *Bufo himalayanus* of the Himalayas. Cranial ridges prominent, these as also the upper lip, tips of fingers and toes, metatarsal tubercle, and tubercles on the palm of the hand have black cornifications in the adult. (These tend to peel off in preserved specimens.) Parotoid glands large and prominent. Tympanum distinct, oval or circular in shape, $\frac{2}{3}$ diameter of eye. First finger equal to or longer than second. The skin is heavily tuberculated and has many black spine-tipped warts. Two series of large warts along the middle of the back, which has otherwise very few tubercles. Crown of head smooth, especially in the larger specimens, or with a few tubercles.

Uniform grey of various shades, brown or reddish with darker markings, ventrally uniform white or speckled with black on the chin and throat.

Juvenile. Dark grey or black or reddish brown above, and ventrally uniform white or speckled with black. The juvenile common toad is likely to be confused with species without cranial ridges as these do not appear till the toad attains a snout to vent length of over 20 mm. (Plate II, fig. 2). The ridges are rather indistinct in specimens of up to 30 mm. length and are cornified only in specimens with a snout to vent length over 35 mm.

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[1] Rao, C.R.N. (1915) : Some South Indian Batrachia. *Rec. Ind. Mus.* **11** : 31.

Secondary sexual characters. The throat of the breeding male is light orange or yellow in colour, very evident when the vocal sac is distended. The male also has cornified callosities on the inner aspect of the first and second fingers during the breeding season.

Distribution. Oriental region and Malaysia.

Breeding. This species is a very prolific breeder. A single female may lay over a thousand eggs, in any convenient patch of water. An excellent description of its breeding habits has been given by McCann (1928)[1]. In the Bombay area, after the first heavy fall of the monsoon rains, the characteristic call of the male, resembling the noise produced by a child's horsehair rattle[2] can be heard in the vicinity of ponds, streams, and rainwater pools. The male, which may be considerably smaller than the female, is very much on the alert at this period, calling from a stone or other vantage point near the water and investigating any movement of other toads in its immediate vicinity. At the approach of a female, several males will scramble around her, the whole group at times resembling a rugger scrum with the female buried under a mass of struggling, kicking males, till one among them is successful in holding on to her with the arms clasping the body of the female behind her forelimbs. The callosities on the fingers permit a non-skid grip. With a male thus firmly established on her back the female enters the water to lay. If the amplexus happens away from water it may be continued till water is available which may be even after several days. McCann (*supra*) records one instance where it was continued for 21 days—this was, however, in captivity. The eggs are laid embedded in a translucent string, which is twisted round the stems of grass and other plants in water by the movements of the animals. In the absence of plants the eggs lie in long strings at the bottom of the pond or stream.

The tadpoles, which are uniform black in colour, hatch in about four days after laying. They are usually gregarious and are omnivorous in diet. They move usually at the surface and feed at the edge of the water, mainly on algae and other plant life, but I have also observed them, in a garden tank, feeding on dead toads which had drowned when unable to get out of the tank.

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[1] McCann, C. (1928) : Notes on Indian Batrachians. *J. Bombay nat. Hist. Soc.* **36** (1) : 154.

[2] An indigenous toy made from horse hair with a weight at one end of the hair, while the other is looped to a groove on a wooden handle.

The metamorphosed toads are very small in size averaging less than 10 mm. in snout to vent length. The period of larval life is not known but this may vary with ecological conditions. Tadpoles of the same clutch metamorphose more or less together; immediately thereafter they migrate from the breeding area and large numbers of young toads may be seen as the young from several clutches laid at the same time start moving. McCann (op. cit.) records seeing several thousand young toads migrating near Kalol in Rajputana in September. Mortality is extremely heavy at this period.

The breeding season extends over a considerable period in south-western India and Assam. Tadpoles have been collected from January (Assam), February (Ootacamund) to August. The main breeding season throughout the country coincides with the arrival of the monsoon. However, in areas where conditions are favourable breeding may occur sporadically during most of the year. The only months in which specimens in breeding condition or tadpoles were not noticed were November and December.

Habits. This toad is the commonest among Indian species and also the amphibian most likely to be seen. It is equally at home in almost all the biotopes found in the country, and occurs from sea-level up to 6000 ft. in the hills. The few biotic requirements of the species, a cool retreat for the day, insect food, and water even of temporary nature to breed, has enabled the species, coupled with its enormous fecundity, to exist under diverse climatic conditions. Except during the breeding season it is nocturnal and spends the day in any convenient cranny which is cool and dark. Once a toad has found a suitable day retreat it will generally use it as its permanent abode and if undisturbed will spend its life-time using it as its base of operations for its nightly forays after food. However, during the breeding season, the toads leave their home range for their breeding sites, their period of absence depending on the distance and conditions at the breeding pool. If conditions are ideal and space permits several toads may occupy the same day hideout. They have very limited powers of hopping and near-by prey which have been spotted by sight or ear are usually walked up to. These toads are mainly insect feeders and consume a large number during their night hunts, and are thus of economic importance. In spite of the protection afforded by the secretion of the parotoid and other glands on the skin, a large number are eaten by snakes and other predators.

Bufo microtympanum Boulenger 1882 : Soulhern Hill Toad

(Plate II, Fig. 4)

Diagnosis. Similar in appearance to *Bufo melanostictus* but distinguished by its very small tympanum which is half or less than half the diameter of the eye.

Distribution. This species is not uncommon in the hills of southern peninsular India.

Breeding. The breeding habits are not known but the tadpoles which are distinguished from those of *Bufo melanostictus* in having the nostrils ¾ the size of the eye (less than half in *melanostictus*) have been collected at Bangalore.

Habits. Unknown.

(To be continued)

Obituary

MARK ALEXANDER WYNTER-BLYTH

Mark Alexander Wynter-Blyth died on the 16th of April 1963 of coronary thrombosis at Leysin, Switzerland, where he had gone from India to spend his vacation.

His death has created a gap in the ranks of naturalists in this country which will be difficult to fill. Mr. Wynter-Blyth will be well remembered for his engaging articles in the *Journal* on butterflies, travels in the Himalayas and the Nilgiri Hills, and the lions of the Gir Forest. His BUTTERFLIES OF THE INDIAN REGION is a most comprehensive work of its type on the subject. The third census of lions in the Gir Sanctuary was completed in May 1962 using the method evolved by him. He conducted the first two counts at the invitation of the then Government of Saurashtra.

He was born at Harrow-on-the-Hill, Middlesex, England, on 15 August 1906, and was educated at Sedbergh School in Yorkshire and Magdalene College, Cambridge. Sedbergh is considered one of the toughest Public Schools of England, and his bent for Nature was acquired during the formative years of his life at this school, as was his spartan attitude towards life, which admirably suited him for his chosen career as a school master.

Wynter-Blyth came out to this country in 1936 as House Master at Bishop Cotton's School, Simla, and when that school opened a preparatory school he was appointed its first Head Master. It was in Simla that he met A. E. Jones, who set him on his lifetime passion for butterflies.

From Simla he went to the Nilgiris as Head Master of St. George's School, Ketti, in 1941. Here he was called up for military service during the Second World War but, being found unfit for active service, was offered a staff appointment which he declined and asked to be allowed to continue at his school, considering that his work there was equally important towards the war effort.

He came over to Saurashtra in 1946 as tutor to the young Maharajkumar of Navanagar, and in 1948 he was asked to take charge of Rajkumar College, Rajkot. He dedicated the remaining years of his life to tirelessly working to make the school one of the best for boys in the country. Mr. Wynter-Blyth devoted his entire life to the cause of education in India, and this school is a fitting memorial to him, its well-loved Principal.

A list of Mr. Wynter-Blyth's papers contributed to the *Journal* is appended below:

Note on *Curetis* species at Kallar. Vol. **43** : 671-2.

Some interesting butterflies. Vol. **44** : 601-2.

A note on the transmission of malaria at Ketti, Nilgiris, 6300 ft. Vol. **44**: 307-9.

The butterflies of the Nilgiris. Pt. 1, Vol. **44**: 536-49; Pt. 2, Vol. **45**: 47-61; Addenda and corrigenda. Vol. **45**: 613-5; Additions. Vol. **46**: 736.

Description of a new dimorphic female of *Euripus c. consimilis* Wd. Vol. **45**: 257-8.

A list of the butterflies of the Simla Hills. Vol. **41**: 716-41; Additions to the list. Vol. **42**: 448; **43**: 672-3; **45**: 256-7; **46**: 735-6.

Note on the butterfly *Valeria valeria hippia* (Fabricius) ♀ form *philomela.* Vol. **46**: 736-7.

An expedition to Sangla in Kunawar. Vol. **47**: 565-85.

The Nilgiris Revisited. Vol. **48** : 246-60.

The Gir Forest and its Lions. Pt. 1, Vol. **48** : 493-514 ; Pt. 2 (with K. S. Dharmakumarsinhji), Vol. **49**: 456-70.

Butterfly collecting in India. Vol. **50**: 885-93.

A naturalist in the north-west Himalaya. Pt. 1, Vol. **50**: 344-54; Pt. 2, Vol. **50**: 559-72; Pt. 3, Vol. **51**: 393-406.

The Lion Census of 1955. Vol. **53** : 527-36.

Book :

BUTTERFLIES OF THE INDIAN REGION (Published by the Bombay Natural History Society, 1957).

K. S. LAVKUMAR

Reviews

1. MANAGEMENT OF ARTIFICIAL LAKES AND PONDS. By George W. Bennett. pp. xvii+283 (23.5×15.5 cm.). With numerous illustrations. New York, 1962. Reinhold Publishing Corporation. Price $ 8.

The introduction of the word 'artificial' in the title of the book points the limitations to its usefulness for those who will be concerned with such waters. However, the principles of management, as elaborated in the book, are equally applicable to natural as well as artificial lakes and ponds. As such, the book can serve as a useful reference for all those who are concerned with the management of captive water resources from the fisheries point of view.

The book is divided into nine chapters. The first one is directed to the concise history of fish management. In the second chapter the author describes in simple language different types of ponds and lakes, giving at places photographs to illustrate his classification. The third chapter embodies information on the usual physico-chemical factors of water, correlating these with the management of lakes and ponds. The next four chapters, dealing with carrying capacity, production, growth, reproduction, competition, predation, techniques of management, and fishing and natural mortality, constitute an important feature of the author's contribution, making the book a useful reference even for workers in the field of fishery biology. The last two chapters, describing fish behaviour, angling, and the commercial aspects of sport fishing, are directed to help those concerned with the management of sport fishing.

Considering the bias with which the book is written, it will evoke admiration from those who seek to manage lakes and ponds scientifically for sport fishing which, as a hobby, has astonishingly increased in the last ten years in western countries, especially in the U.S.A. Even otherwise, the book is a useful addition to the libraries attached to institutions concerned with pisciculture and general work on fishery biology.

H. G. KEWALRAMANI

2. COLLINS GUIDE TO BIRD WATCHING. By R. S. R. Fitter. pp. 254 (20×13.5 cm.). With 40 monochrome plates and 49 line drawings. London, 1963. Collins. Price 21*s*. net.

Here is a very well brought out little book, unique in that it combines conciseness with full comprehension and is richly illustrated with compelling line drawings and attractive photographs. True, it is written for bird watching in the British Isles and so to some extent is of limited scope for birdmen elsewhere. Even so, it is a very welcome addition to any library and is of special worth for those just started on the hobby, or those contemplating getting to know birds; the entire lay-out is for such people, and there is a lot of very practical information which can be of aid in taking the first steps into this richly rewarding hobby.

This book approaches the subject from a very novel angle—the novice birdwatcher; the author treats the subject with great care and perspicuity lest his reader might stumble, and very soon the simple text unfolds the intriguing vistas of the natural history of birds.

The first part of the book tells how to start—a thing which in itself makes the book worth possessing. After learning the various parts of a bird and what to look for, there are simple instructions on the care of binoculars, the keeping of notes, and the attracting of birds to gardens by bird-tables, bird-baths, and nesting boxes. Bird ringing, photography, scientific investigations, and conservation laws are all discussed. The second part deals with the identification of British birds. As many species found in Britain visit us during the winter, this section of the book is likely to be of use to people in India. The novel method of grouping birds according to their habits or habitats, with a common type species as an introduction to each group, is most convenient for a beginner.

The third section of the book is of less value to us in India, but the manner in which the habitats have been recognised and their typical bird groups described suggests a new approach towards identifying birds, and also draws attention to the importance of plant communities in bird distribution, population densities, and community set-ups. It also provides detailed information on sanctuaries, special birds of each locality, and Societies and regional literature of all the counties of the British Isles, and gives a portrait of efficient co-operation among the birdwatchers of the U.K. In fact, any visitor to that country, known for its phlegmatic exterior to outsiders, will find this book a key to the warm heart of a nation of birdwatchers.

Y. S. SHIVRAJKUMAR

3. SURVIVAL OF THE FREE. Edited by Dr. Wolfgang Engelhardt. Translated from the German by John Coombs. pp. xiv+257 (24×18 cm.). Numerous illustrations in colour and monochrome, and nine maps. London, 1962. Hamish Hamilton. Price 30*s*. net.

Part One of this book includes over 140 first-class photographs of wild animals and birds, including six in colour. Such a magnificent collection is seldom brought together, and the short paragraphs on the different species add to their value. In spite of occasional slips, probably introduced in the course of translation, the book contains many interesting facts and figures which may help to convince more people of the necessity for wild life preservation and also perhaps for the control of human population—130,000 persons are born every day and, by the year 2000, the human population will have increased from 2800 million (1960) to 6900 million, assuming of course that no atomic war intervenes.

In Part Two different people relate their experiences in various National Parks and Nature Protection areas, and Part Three has more detailed and critical accounts of National Parks, Game Protection, Hunting, and their Problems.

The volume concludes with a list of National Parks and other important Nature Protection areas. Under India, E. P. Gee's INDIA'S WILD LIFE SANCTUARIES (1961) is warmly recommended, and the following 16 areas are mentioned: Dachigam Sanctuary (Kashmir), Corbett National Park, Keoladeo-Ghana Sanctuary, Shivpuri National Park, Chandraprabha Sanctuary, Hazaribagh National Park, Jaldapara Government Reserve, Manas Government Reserve, Kaziranga Government Reserve, Gir Forest, Kanha National Park, Ranganthittoo Sanctuary, Vedanthangal Sanctuary, Bandipur Sanctuary, Mudumalai Government Reserve, and Periyar Sanctuary. Curiously, serow are said to occur at Shivpuri, Chandraprabha, and the Gir!

The Kruger Park in South Africa was opened in 1926 and visited by the occupants of 3 cars in the following year. In 1960 there were more than 140,000 visitors. In America, the National Park authorities reckon they will receive 80 million visitors by 1966 and, even today, every third American visits a national park at least once a year. The corresponding figures for India would be microscopic, and one wonders how far conditions here warrant Sir Julian Huxley's statement in the Foreword: 'The world has at last become aware of the fact that wild life is one of its most precious resources and yet is threatened with extinction.'

H.A.

4. GOMA, THE BABY GORILLA. By Ernst M. Lang. pp. 62 (25×19.5 cm.). 56 Monochrome plates. London, 1962. Victor Gollancz Ltd. Price 21*s*. net.

The gorilla with a few other beasts equally temperamental has refused to breed in captivity. The birth of a gorilla in an Ohio zoo in 1956, therefore, was a historic event. Soon after, Europe got its first zoo-born gorilla—at Basle. The mother seemed unable to care for the baby, and so it came about that Goma was adopted into the home of the Director of the zoo, Ernst Lang.

If Goma demanded as much care as a newborn human baby, she was as lovable and charming. It is interesting to remark that no visitor ever felt repelled by the little ape—on the contrary, women wanted to cuddle and fondle her, as they would a human baby.

Not that Mr. Lang and his family fell into the habit of regarding Goma as human. The first two years of Goma's life are recorded carefully and accurately and—this is important—without any trace of sentimentality. It is a completely fascinating story, with many surprises for those of us who are unacquainted with this particular animal—and most of us are. I discovered, for example, that the gorilla laughs, that he goes off his feed when teething starts, that he is our nearest relative among the primates—in fact every page of the 60 pages or so was a discovery.

I know for certain that as a child I would have been excited to receive this book as a gift. The writing is clear enough to be read by or to most children between 10 and 14. As for the photographs, there is no period in our brief threescore years and ten when they would not be utterly delightful.

Goma's mother has given birth to another baby, and this time she is able to care for it. We therefore look forward to another volume telling us of the development of a gorilla baby under its mother's care.

I.R.

5. SILENT SPRING. By Rachel Carson. pp. 368 (22×15 cm.). With 17 black and white drawings. Boston, 1962. Houghton Mifflin Company. Price $5.00.[1]

All thinking persons should read this book. Insecticides have become so much a part of our daily life that we no more question their use than we would that of soap. Miss Carson has brought together a great deal of information to shatter our complacency. Disturbing reports have been coming in for years, but they have been hidden in the scientific literature and this is the first time they have been presented to a wider public. In spite of the uncompromisingly scientific nature of the subject the book is absorbingly readable. This will not surprise anyone who has read any of Miss Carson's earlier books.

Insecticides act by interfering with vital processes in the body. Unfortunately these effects are not confined to noxious insects; other forms of life suffer. An example of this was seen in E. Michigan where elm trees were sprayed with DDT to rid them of bark beetles, carriers of Dutch elm disease, a fungus. All seemed well till the following spring, when migrating robins returned to their territories and began dying in large numbers. Each new wave of migrants was wiped out in about a week and few nests and young were seen. What had happened was that the DDT formed a water-resistant film on the elm leaves; in autumn the leaves fell and were eaten by earthworms, which thus accumulated large quantities of DDT in their bodies, and in spring the robins ate the earthworms. It was estimated that eleven large earthworms contained enough DDT to kill a robin! Paradoxically, instead of Dutch elm disease being reduced, it actually spread faster in the sprayed areas. This was because the natural enemies of the bark beetle were killed. The only effective method of control was found to be the immediate destruction of the diseased trees.

There has been wholesale destruction of other wildlife also. Fish have died in streams after overhead spraying, and in Britain foxes are known to have died in large numbers, perhaps from eating poisoned birds and mice. When the dead creatures have been analysed large amounts of DDT have been found in fatty tissues. The accumulation of DDT in tissues is one of its most alarming features. It makes nonsense of the concept of 'safe residues' of insecticides which are permitted on foodstuffs for human consumption. No one appears to have considered the cumulative effect of numerous 'safe' doses throughout an individual's life.

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[1] Also published in Great Britain, 1963, by Hamish Hamilton, London. pp. 304 (21 × 13 cm.). Price 25*s.* net.

There is evidence that DDT reduces fertility in birds. It has been found in their gonads, in unhatched eggs, and in newly-hatched dead nestlings. Whether such effects occur in man is at the moment speculative. Miss Carson presents evidence to show that chemicals may act like radiation in bringing about genetic and carcinogenic changes. The evidence that insecticides are linked with malignant anaemias and leukaemias appears to me to be inadequate. A large number of case histories of sufferers from these diseases have been collected in the States, and all 'had been exposed to these environmental agents, with a fair amount of exposure'. With the amount of insecticides that are being used these days in the States this statement must surely be true of nearly everyone. Without histories from a control group of normal persons this statement is not very conclusive, though it may be *suggestive*. This is perhaps a quibble. There is certainly enough evidence on the point to disturb, but I feel that the author cheats somewhat in this section by presenting the evidence so as to suggest that it is better than it is; this is a pity in a book which is otherwise so logical.

What is urgently needed today is the reassessment of the biological effect of chemicals and a more realistic policy for controlling their use—as Miss Carson points out, this will clash with a great many vested interests, and more money will have to be spent on the development of other means of control. The only permanent solution is a more basic knowledge of the relationships between different forms of life, and the wise use of it to 'promote an even balance and damp down the explosive power of outbreaks and new invasions'. Spectacular results have already been achieved. The screw-worm, a pest of livestock, was eliminated very ingeniously in Florida. Large numbers of male screw-worm flies, bred in the laboratory, were sterilized with gamma rays and released. They mated with normal female flies, with the result that the eggs laid were infertile and the population of the flies was reduced. Successive releases have eliminated the screw-worm. Preliminary trials where large numbers of sterilized male mosquitoes were released into a population have not been a success, and it will take years of patient research to find biological solutions to all our problems. Meanwhile our insect problems are pressing. No one can deny the enormous reduction in the incidence of malaria, plague, and kala azar, to mention only a few, following the discovery of DDT, and Paul Müller the discoverer richly deserved his Nobel Prize. So, until the permanent solution is found, it seems most sensible to follow the advice of Dr. Briejer, Director of Holland's Plant Protection Service: 'Spray as little as you possibly can', rather than 'Spray to the limit of your capacity'.

Most of the appalling destruction described in this book was quite unnecessary, and we are in Miss Carson's debt for pointing this out.

R.R.

Miscellaneous Notes

1. THE WILD DOG [*CUON ALPINUS* (PALLAS)] AND THE TIGER [*PANTHERA TIGRIS* (LINN.)]

During a short visit to Kanha National Park in February 1963, an interesting incident throwing further light on the relations between the wild dog and the tiger came to my notice and is recorded below.

On the 20th February at about 3 a.m., loud alarm calls of chital and swamp deer near Kanha Forest House indicated the presence of a large carnivore in the vicinity. At about 8 a.m., vultures and crows were seen collecting near a spot in the forest hardly a kilometre from the Forest House. Some local boys, sent to investigate, soon returned rather frightened and reported that a fight between a pack of wild dogs and a tiger was in progress and that they had heard at very close range the fierce growls of the tiger and the yaps of wild dogs. After making loud noises to scare away the fighting carnivores, I visited the spot with some local people. About a dozen wild dogs were seen feeding on the kill, a chital doe. They left the kill 'under protest' on human approach. The tiger could not be seen but the details of a grim drama of the Indian jungle could easily be made out. An old, thick and straight sal tree (*Shorea robusta*) about 10 metres from the kill was profusely covered with fresh claw marks of the tiger up to a height of about 5 metres. The lowest branches of the tree were at a height of about 7 metres. Obviously the tiger had not succeeded in climbing the tree and had slipped down and been attacked by the wild dogs. The leaves below the tree were smeared with blood drops which could be followed deep into the forest showing the route of the retreat of the mauled tiger. Tiger pug marks near the dead chital and the other marks at the spot suggest that the tiger killed the chital and was chased away by the wild dogs. The fact that the tiger was able to kill a deer and to ascend a branchless tree up to the said height shows that it was quite healthy.

CENTRAL REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
JABALPUR,
May 4, 1963.

H. KHAJURIA

[Lt.-Col. R. W. Burton in 'The Indian Wild Dog' (*Journal*, Vol. **41** : 691-715) lists records of fights between wild dog and tiger and suggests that the most frequent reason for such encounters probably is 'the killing by a tiger of an animal being hunted by the dogs and the ensuing fight for their quarry by the ravening pack'.—EDS.]

2. 'BAT MIGRATION IN INDIA AND OTHER NOTES ON BATS' : A CORRECTION

In my paper 'Bat Migration in India and Other Notes on Bats' (1948, *J. Bombay nat. Hist. Soc.* **47** : 522-526) I mentioned *Rhinolophus rouxi* (Temm.) as one of the bats ringed at Elephanta Island, Bombay, by me together with Sálim Ali and Charles McCann. In May 1963, when I visited the island with Lord Medway, he drew my attention to the fact that the smaller bat with pointed ears (which in my paper I had referred to as *Rhinolophus rouxi*) was in fact *Hipposideros speoris* (Schneider). Later, at the Society's Office, we verified that four specimens collected by McCann in 1942 and marked *R. rouxi* are in fact *H. speoris*. This error was noticed by M. Brosset when examining the skins in the Society's office, but was not then separately recorded as I thought it would be referred to in his paper. It would appear, therefore, that our earlier notes were based on a wrong identification.

Incidentally, several of the bats seen by us in May 1963 bore rings, presumably those placed by Brosset in November 1959 and February 1961 (1962, *J. Bombay nat. Hist. Soc.* **59** : 612).

MESSRS FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY 3,
July 18, 1963.

HUMAYUN ABDULALI

3. A PIEBALD *RATTUS NORVEGICUS* (BERKENHOUT) FROM BOMBAY

(*With a plate*)

During the rat-flea survey of G/north Ward of Greater Bombay a curious solitary female specimen of rat was trapped on 6 February 1960 in the locality of Library Road, Dadar. It was heavily infested, all twenty-five fleas being *Xenopsilla cheopis* (Rothschild).

The specimen, identified as *Rattus norvegicus* (Berkenhout), had the posterior two-thirds of the body white, except for a streak of brown in the mid-dorsal line continuing from the anterior third of the body, which was the normal brown. The tail had brown hair on the upper side but only a few hairs on the lower side, and consequently appeared pale and scaly beneath. The terminal portion of the tail, over 25 mm., was white. Measurements were: head 30 mm., body 120 mm., tail 140 mm., ear 20 mm. long and 15 mm. wide, weight 93 gm. The accompanying photographs give a clear idea of the colour pattern.

The specimen bears some resemblance to that described by Romer (1949) from Hong Kong, but is more regular, and indeed bears a close resemblance to the domestic rat of the 'hooded' pattern. Romer claimed that his specimen must have been a naturally-occurring albino, since domestic rats were not imported or kept in Hong Kong. In Bombay the possibility of hybridization with a domestic albino rat cannot be ignored, although we are not aware of the presence of a strain of 'hooded' domestic rats. The pattern is also similar to one of those described by Harrison & Lim (1951) from the wild forest rat, *Rattus cremoriventer*, in Malaya.

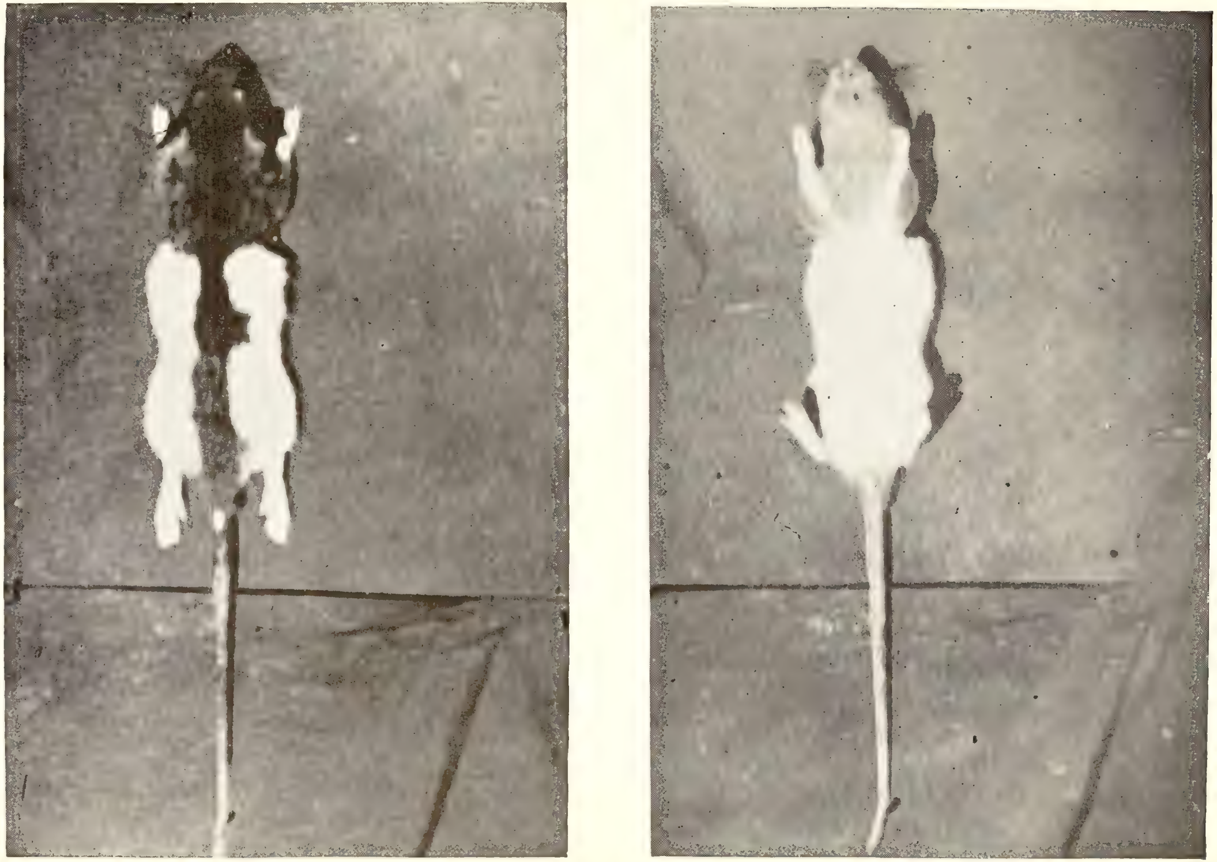
Naturally-occurring albinism appears to be rare in *R. norvegicus*, although it is known in *R. rattus*. Hossack (1907) refers to part albino house rats of this species in Calcutta, and both Gibson-Hill (1950) and Harrison (1950) note the occurrence of part albinos, while the former records a full albino *R. norvegicus* from Singapore. Harrison (1950) appeals for statistics of the frequency of such albinos as of value to quantitative geneticists. The Plague Investigation Commission in India (1912) has recorded data for such albinism (white belly) in *R. rattus* from Bombay. Figures from the rat-flea survey as recorded by us for the period August 1959 to November 1959 from the suburban area of Bombay (Bhandup) relating to part-albinos are as follows:

Species	No. examined	No. of albinos
R. rattus	682	16

The skin of the piebald specimen of *R. norvegicus* is preserved in the Entomology Department, Haffkine Institute, Bombay.

We are thankful to the Director and the Assistant Director (Entomology) for the facilities and help given to us. Our thanks

A Piebald *Rattus norvegicus* (Berkenhout)



Dorsal view

Ventral view

are also due to Dr. J. L. Harrison, Singapore University, for valuable suggestions.

BIOLOGY DEPARTMENT,
RUPAREL COLLEGE, A. K. JOSHEE
BOMBAY 16,

THE COMMONWEALTH INSTITUTE OF
BIOLOGICAL CONTROL, K. M. KAMATH
BANGALORE 6,
May 25, 1963.

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4. THE NILGIRI TAHR [*HEMITRAGUS HYLOCRIUS* (OGILBY)] IN CAPTIVITY

Thanks to the generosity of the management of the Kanan Devan Hills Produce Co. Ltd., Munnar, it was possible to obtain, from their sanctuary near Vagavurray Estate, a pair of Nilgiri Tahr *Hemitragus hylocrius* (Ogilby) for the Trichur Zoo. They were captured when hardly ten days old and transported to Trichur in a large dealwood case, well padded with straw. When the two kids arrived at the Zoo, on a hot December afternoon in 1959, they looked so small and helpless that their chances of survival seemed slender. But with proper care, they have not only survived but acclimatized themselves to the Zoo and even raised a family. Bamby is now the mother of two kids, Párvati born on 27-4-1962, and a male born on 9-2-1963. Cookei, the father, is now a 'saddle-back'.

From the time of capture, fresh cow's milk diluted with water was their sole sustenance for a long time. It was fed to them out of a feeding bottle at regular intervals night and day. The animals were kept in a sheltered verandah next to the library instead of in their paddock, for safety and closer attention.

Their umbilical cords were still intact when the kids arrived at the Zoo. Bamby, which came from a different herd, was a shade taller than Cookei and had a dark-grey back, with paler flanks and white belly. Cookei's colour soon deepened and both looked almost alike, except for Cookei's horn-knobs being more prominent and his face slightly shorter. Their eyes were dark brown with the pupil darker and horizontal. The muzzle was calico-black and, under stress of exertion, a moustachial streak of black would issue out of each nostril. There was a whitish circle around the eye and a black, oblique streak in front of each foreleg. The hair inside the ears was parted in four grooves, as in the Barbary sheep. When measured on 14-1-1960, just when they were about a month old, Cookei stood 17 inches at the shoulder and Bamby 18 inches.

Besides milk, the young animals loved to nibble at pieces of earth, laterite, dry leaves, and paper, while they licked with obvious relish the plaster off walls, the hands of the attendants, the seats and arms of chairs, and dust settled on the old book-cases. Later, they began to browse on the tender grass of the lawn and developed a partiality for the leaves of *Bridelia retusa*. *Hibiscus* and *Ficus* leaves were also eaten. So was *Tridax procumbens*, a common weed in the compound, but not *Boerhavia*, another common plant. Their present food consists of soaked Bengal gram, grass, leaves of the jak-tree, and ripe bananas.

The kids were most active after their feed of milk and kept dashing up and down the verandah, sometimes together, sometimes in opposite directions. In this mad career, their sure-footedness alone saved them from crashing into one another. When they ran, all four legs were off the ground. I have seen Cookei leap over the height and length of Bamby at one bound. The wall of their present run is nearly 8 ft. high, but this had to be provided with a 3-foot top-railing to prevent them from jumping over.

After play and exertion, they generally dropped down to rest just where they happened to be at the moment. The usual posture was with the legs folded beneath the body, head raised and attentive. But when really relaxing, the legs were stretched sideways with the neck either drawn forwards or curved around to rest on the body. They liked to sleep during the hottest part of the day. When fast asleep, they did not seem to mind small noises. On rising fully rested, they would stretch their bodies, holding their front legs erect and hind legs depressed and then give themselves a vigorous shake. Bamby invariably urinated on the gunny bag supplied to her before lying down, and Cookei at times pawed the ground as a prelude to repose.

In their earliest infancy, both the animals were tame and confiding, but with the passage of time, they became timid and suspicious and would start at every unfamiliar sound. They got upset when doors were opened or shut, or someone trod on dry leaves and made a rustling sound. Bamby, when parted from her mate or otherwise disturbed, showed her restlessness by a sharp circular motion of the neck. This habit of twisting the neck is occasionally present in cattle, and such animals are looked upon with superstitious dread in parts of Kerala. Cookei was free of this habit. I once saw him curl up in fright at the call of a Paradise Flycatcher from a neighbouring tree. Bamby's hair literally stood on end at the sight of her first mosquito. Their hearing is acute and senses of smell and sight well developed. Both have a plaintive bleat like a goat's but, under excitement of chasing one another or of fight or fright, they emit a loud hiss.

Two or three days after their arrival at the Zoo, Cookei mounted Bamby in the copulatory posture, but with no servicing movements. Bamby, at times, also behaved in the same way. Towards the close of the first year, Cookei began to make passes at Bamby and also at passers-by. This became such a nuisance that the animals had to be transferred to their present run. Here he was seen to be constantly making advances to Bamby with back arched and head lowered, but stopping short on getting close and contenting himself by stroking her once or twice with his forelegs. Any attempt to mount was prevented by Bamby moving away. When visitors approached the cage, Cookei transferred his advances to them, putting out his head and making clicking noises with the tongue. Actual copulation was not observed by me and is presumed to have taken place at night. I am thus unable to give the exact gestation period. No special rutting season was noticed; the male made advances to the female in all the months of the year.

The animals seldom fought, although they butted at each other playfully. The moment Cookei became really aggressive, as at feeding time, Bamby would move out of his way. Earlier, they had allowed themselves to be led about by their ropes, but Cookei soon started butting at the attendants. Once roused, he would not leave off, even if belaboured with a stick. On one occasion, an attendant was badly gored by him and had to be sent to the hospital. On another occasion, a man who jumped over the wall to pick up something he had thrown into the run was attacked and severely wounded. The goats themselves once jumped over the partition wall into the adjoining deer-run. While the authorities were in dread of the diminutive creatures being crushed to death by the stampeding sambar and spotted deer, what actually happened was that the goats had put the inmates to rout and sent them galloping to the farthest end of the paddock, after which they wandered about in supreme nonchalance until roped and led back to their own cage.

They have not suffered from any serious illness during the three and odd years of their life at the Zoo. Periodical examination of the faeces has revealed them to be free of internal parasites. Also, no external parasites have been noticed so far. But they are subject to attacks of severe cold during the hot months.

'BELL-VIEW,'
DEWAN'S ROAD,
ERNAKULAM, KERALA,
May 20, 1963.

N. G. PILLAI

5. RESCUE AND RINGING OF FLAMINGOS IN KENYA COLONY

In October 1962 a local daily newspaper published a report about flamingos dying by the thousand on Lake Magadi in Kenya Colony. Enquiries made by Mr. Humayun Abdulali have elicited the following information from Mr. Leslie Brown, President, East African Natural History Society, which we are glad to publish. There were colonies of both species of flamingos, Lesser Flamingo (*Phoeniconaias minor*) about 1,000,000 pairs and Greater Flamingo (*Phoenicopterus ruber*) about 10,000 pairs. Between 800,000 and 900,000 young hatched. Shortly after hatching many young birds were affected by the saturated solution of soda in which they were moving forming heavy balls of soda round their legs. There was a generous response to appeals for helpers and funds, and active rescue efforts were put in train at a very early stage. Teams of catchers caught the affected young and knocked off the soda anklets. It is estimated that about 30,000 lives were saved by this method. In addition, about 100,000 more young were saved by driving them into water in which the solution of soda was not so concentrated and where the anklets did not form. The final saving was the ability of the young to move to the southern end of the lake, and the early arrival of the rains in

October which diluted the solution of soda in the water of the lake.

Late in November Mr. Brown estimated the number of young at about 400,000, which would give a breeding success of rather less than 50%. Further mortality occurred later among the last-hatched young owing to the parents having to fly long distances to get food (to Lake Natron and back, a good sixty miles a day). Even so, making allowances for the unusual conditions, the proportion of breeding success would not compare very unfavourably with that in a normal year in the usual breeding ground in the centre of Lake Natron.

The tragedy has a redeeming feature in so far as the big organisation set up for rescuing the young made it possible to ring the flamingos on a large scale. As was mentioned in 'Notes and News' in our last issue, 8000 young Lesser Flamingo were ringed. It is hoped that some definite information about the migratory movements of the two species of flamingo will now be obtained.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6-WB,
June 17, 1963.

EDITORS

6. ON THE ALLEGED INFERIORITY OF THE SOUTHERN GRACKLE [*GRACULA RELIGIOSA INDICA* (CUVIER)] AS A TALKING BIRD

A conversation I had recently with Mr. K. I. Mathew, State Wild Life Officer of Kerala, suggests an explanation for the widespread belief that Pahari Mynas from north India (*Gracula religiosa intermedia* and *G. r. peninsularis*) are better talkers and learn more readily than south Indian birds (*G. r. indica*), a belief that bird dealers take advantage of by asking for ridiculously high prices. The majority of the birds that come from Gorakhpur, U.P., and from eastern and northern central India are taken as nestlings; they are therefore reared in captivity and become conditioned to human handling and the sophisticated noises of human society. As against this, I learn from Mr. Mathew that in Kerala these birds are caught with bird lime when they collect in large flocks to feed on the nectar of the freely flowering forest shrub *Helicteres isora*; that is to say, their training does not begin till they are adult. To my suggestion that the few southern birds that talk well may be hand-reared, Mr. Mathew confirmed that fledglings taken at the nest do, in fact, learn to talk quite proficiently.

During the ornithological survey in Orissa in 1950, I learnt that the right to collect Pahari Myna nestlings was auctioned along with other forest rights, and at a royalty of 4 annas (=25 nP.) per bird brought the State an annual income of about Rs. 3000. This, along with nestlings destroyed or unaccounted for in the process of collecting, represents an enormous drain, the effect of which calls for serious consideration.

33, PALI HILL,
BANDRA, SÁLIM ALI
BOMBAY 50,
June 6, 1963.

7. OCCURRENCE OF THE VERDITER FLYCATCHER, *MUSCICAPA THALASSINA THALASSINA* SWAINSON (PASSERIFORMES : MUSCICAPIDAE) IN KATHIAWAR PENINSULA

The Verditer Flycatcher (*Muscicapa thalassina thalassina* Swainson) is so far not recorded from the peninsula of Kathiawar, although it is known to over-winter in the greater part of northern and peninsular India. Dharmakumarsinhji (1954, BIRDS OF SAURASHTRA : 429) lists the bird as not recorded from Saurashtra, but occurring in the mainland of Gujarat. Therefore, it was of interest to notice the occurrence of this bird in the Gir forest of Saurashtra which I had occasion to visit during November-December 1962. Three specimens of this bird were seen on 10 December 1962 at Chhodawadi in the Jamwala Range, on the forest track leading to Jasadhar, about ½ kilometre from the Forest Rest House. The area was light forest adjacent to hillside where the undergrowth was burnt out, probably to facilitate timber operations. The birds were darting about among the denuded branches of the trees (*Salmalia malabarica*) on the forest roads and making short sallies after insects. Baker (1924, FAUNA OF BRITISH INDIA, BIRDS **2** : 239-240) speaks of the bird as very sociable and often to be seen moving about in pairs. The birds seen by me seemed to be moving about alone. They are said to be not common in Gujarat; this seems to be the case here also, as they were not seen again in a stay of approximately a month.

One specimen, a male, was collected.

I am thankful to Dr. B. Biswas of the Zoological Survey of India for kindly confirming the findings.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM, G. U. KURUP
CALCUTTA 13,
April 15, 1963.

[Sálim Ali in 'The Birds of Gujarat', *Journal* Vol. **52** : 747, gives the status of this species as: 'Winter visitor. Sporadic solos, or separated pairs, amongst groves of leafy trees near villages, and in wooded compounds, etc.'. We have with us an unpublished manuscript, dated October 1950 and received in the Society's office in the same month, by Y. S. Shivrajkumar wherein the species is recorded from Jasdan, Saurashtra, in winter.—EDS.]

8. ADDITIONS TO THE LIST OF BIRDS EATING THE FRUIT OF YELLOW OLEANDER (*THEVETIA NERIIFOLIA*)

Some time ago, I recorded in this *Journal* (**56** : 639) that Redvented Bulbuls (*Molpastes cafer*) and Whitebrowed Bulbuls (*Pycnonotus luteolus*) feed on the fleshy mesocarp of the fruit of the Yellow Oleander (*Thevetia neriifolia*). I referred therein to notes by other authors recording the same habit in the Koel (*Eudynamys scolopacea*), the Common Myna (*Acridotheres tristis*), and the Common Grey Hornbill (*Tockus birostris*).

During the latter half of last year my wife and I observed Brahminy Mynas (*Sturnus pagodarum*) and Redwhiskered Bulbuls (*Pycnonotus jocosus*) in our compound eating this fruit. Brahminy Mynas are local migrants on this campus arriving by about September and departing by about March, whereas Redwhiskered Bulbuls are residents. Usually the Brahminy Mynas feed in company with the Common Mynas and Hoopoes in the grass lawns of this estate. Occasionally they take to eating this fruit, but always the over-ripe ones fallen on the ground. We have noted them sometimes eating the mesocarp of even the stale or the dark and dried fruit. When disturbed, they fly off but come back soon to resume eating, each bird thereby finishing almost a complete fruit.

We suspect the Crow-Pheasant (*Centropus sinensis*) to have this habit but have seen only one instance of such feeding. We have only one or two of these birds round about our house, so it may take time before we can definitely include the Crow-Pheasant in this list.

In all these present instances the unripe fruit full of latex on the plant is never touched.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM, SOUTH INDIA,
April 15, 1963.

P. J. SANJEEVA RAJ

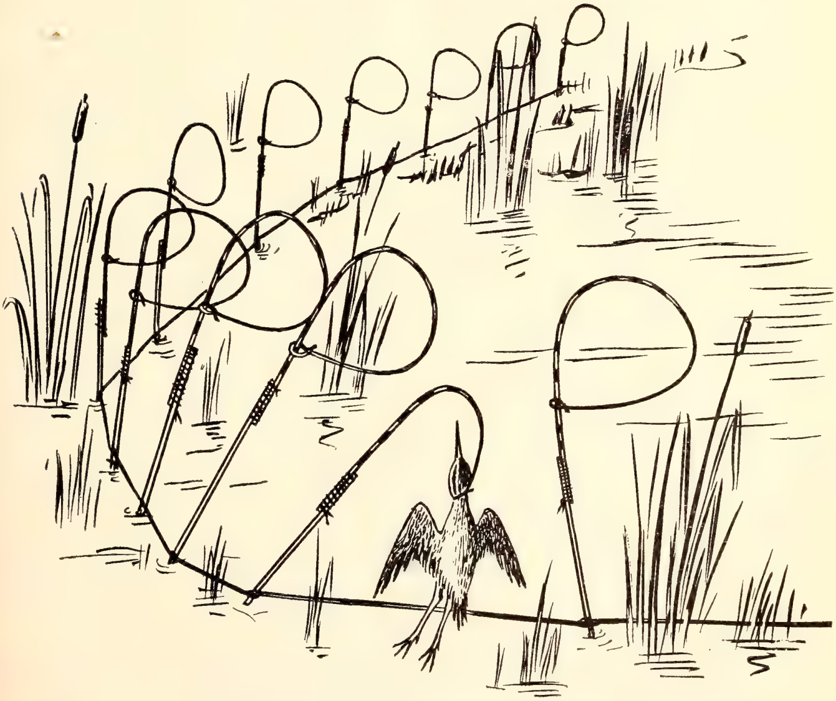
9. POINT CALIMERE AS A REFUGE FOR WINTERING SHORE BIRDS

(*With a text-figure*)

The Asian Section of the International Council for Bird Preservation (ICBP) whose headquarters are in Tokyo, Japan, has been fully alive to the need for a proper investigation of the movements of migratory wading birds (Charadriidae) in south and south-east Asia, and anxious to promote the establishment of refuges for them while on passage or wintering in these countries. The Section was recently allotted a small monetary grant by the World Wildlife Fund through the world body (ICBP) for the furtherance of this objective, a part of which it has passed on to the Indian National Section for appropriate utilization. Partly to prospect in this connection and partly in order to explore the possibilities of netting shore-birds for investigating their role, if any, in the dissemination of arthropod-borne viruses (cf. the BNHS/WHO Bird Migration Field Project), but chiefly at the invitation of the Government of Madras to assess the suitability of Point Calimere for their proposed shore-birds sanctuary, I visited the area from 10th to 16th November 1962.

Point Calimere (10° 18′ N. × 79° 51′ E.) lies in the Tanjavur (Tanjore) District of Madras State, about 200 miles south of Madras City. The area is an extensive coastal belt of some 50,000 acres (or more ?) of tidal mudflats, salt marshes, and lagoons along the southern Bay of Bengal, and about 30 miles from the Jaffna Peninsula of Ceylon across Palk Strait. The stunted scrub jungle bordering the backwaters and mudflats consists of shrubs and moderate-sized trees of *Mimusops hexandra, Memecylon edule, Bassia latifolia, Carissa carandas, Eugenia jambolana,* and other species. Further inland from the edge, the scrub becomes denser and merges into thorn forest, interspersed here and there with open low-lying grassy maidans. Considerable numbers of cheetal, blackbuck, and pig are still to be seen here though reportedly much reduced by poaching. The thick shrubbery—up to 10 or 12 feet high—consists largely of *Dichrostachys* sp. (an acacia-like plant with yellow-tipped pink pompom flowers), *Randia dumetorum, Zizyphus oenoplia, Carissa carandas, Cassia fistula* and *C. auriculata*, and other species. Contrary to the season in the Bombay area, *Gloriosa superba* was flowering profusely everywhere in this terrain. Also, an epiphyte—*Vitis quadrangularis*—was common on the trees.

Bird life was not particularly abundant in the scrub jungle though of considerable variety. But the mudflats and shallow lagoons were (at the time of my visit) alive with wading birds—sandpipers, plovers, etc.—in addition to the large flocks (thousands) of flamingos (*P. ruber*), for whom they are reported to be regular feeding grounds in winter. In a trial catch with the help of a local professional fowler using rows of upright *Borassus* palm fibre nooses (see sketch) strung out more or less at random along the mudflats, over 120 birds were taken within a few hours including such species as *Philomachus pugnax*,


Borassus palm fibre nooses used by local fowler

Charadrius mongolus, C. alexandrinus, Tringa totanus, T. stagnatilis[1], *T. glareola, Calidris minutus,* and others—also two Roseate Terns (*Sterna dougalli*) and a single Rednecked Phalarope (*Phalaropus lobatus*). With the co-operation and collaboration of the Wildlife Preservation Department of the State, it seems possible to do very profitable large scale ringing of shore-birds in this locality, using mist nets and decoys, and also other local techniques.

Little is known about the migrations of the Charadriidae that visit India in winter, and nothing at all regarding their significance as arthropod-borne virus disseminators; Point Calimere offers an exceptional venue for these studies. As a result of my prospecting, it was planned to send out a BNHS field party in December to commence ringing work, but owing to certain procedural snags permission for netting could not be granted by the Madras Government. It is to be hoped that these difficulties are only of a temporary nature and that it will be possible to utilize the opportunities to the full during the coming autumn.

According to a recently retired lighthouse keeper of Point Calimere lighthouse for 25 years, large numbers of birds ('land as well as aquatic') are regularly observed every year between late August and early November flying over Point Calimere 'in a steady stream' in a southward direction across Palk Strait and towards Ceylon. It would be interesting to investigate this report in greater detail. Large numbers of the Indian Pitta (*Pitta brachyura*) are also reliably reported to pass through Point Calimere on their way south to Ceylon for a fortnight or so in every October. In view of our utter ignorance regarding the local migrations of this conspicuous species the place would seem to provide a wonderful opportunity for intercepting and ringing these birds in adequate quantity.

33, Pali Hill,
Bandra,
Bombay 50,
May 13, 1963.

SÁLIM ALI

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[1] One of the ringed Marsh Sandpipers (*T. stagnatilis*) has since been recovered in the U.S.S.R. For particulars see p. 461—EDS.

10. RECOVERY OF RINGED BIRDS

Species and Ring No.	Date and place of ringing	Date and place of recovery	Remarks
**Passer domesticus parkini*? Bombay A-10270	23-3-1962. Bharatpur, Rajasthan, *c.* 27° 13′ N., 77° 32′ E.	2-6-1962. Near Chemolgan, Kaskelan Dist., Alma-Ata region, Kazakh SSR., *c.* 43° 12′ N., 76° 37′ E., *c.* 1800 km. directly north of Bharatpur	Reported by the Bird-Ringing Bureau, USSR Academy of Sciences, Commission for Nature Protection, Moscow, USSR
**Motacilla flava beema* Bombay A-33005	2-2-1963. Edanad, Chenganur, Alleppey Dist., Kerala, *c.* 9° 20′ N., 76° 38′ E.	10-5-1963. Neighbourhood of Nowabad, Bagrami village, east of Kabul, *c.* 34° 30′ N., 69° 13′ E., *c.* 2800 km. north of Edanad	Reported by Dr. D. Meyer-Oehme, Teacher of Biology, Royal Afghan High School, Kabul, Afghanistan
**Motacilla indica* Bombay AB-7960	25-2-1963. Do.	25-4-1963. Tiddim, Chin Hills, Burma, *c.* 23° 50′ N., 93° 70′ E., *c.* 2400 km. NE. of Edanad	Shot with a catapult. Reported by Mr. Khup Khan Kap, Lailo Village, P.O. Tiddim, Chin Hills, Burma
Anas querquedula Moskwa E 527297	22-7-1961, ad. ♂ ringed at the nest, at the mouth of River Svir (*c.* 55 km. N-0 from town of Novaya Ladoga) *c.* 60° 30′ N., 32° 50′ E., Leningrad District	28-12-1962. Shot near a tank between Jakapur and Kundanpur in Sangli District, Maharashtra State	Shot and reported by the Rajasaheb of Miraj, Maharashtra State
**Motacilla flava thunbergi* Bombay A-22268	16-12-1962. Edanad, Chenganur, Alleppey Dist., Kerala, *c.* 9° 20′ N., 76° 38′ E.	16-5-1963. Found dead. Southern part of Karaganda region, Kazakhstan, USSR, *c.* 46° N., 72° E., *c.* 4170 km. north of Edanad	Reported by Bird-Ringing Bureau, USSR Academy of Sciences, Commission for Nature Protection, Moscow, USSR
**Tringa stagnatilis* Bombay AB-1690	12-11-1962. Point Calimere, Tanjavur (Tanjore) District, Madras State, *c.* 10° N., 80° E.	4-5-1963. Shot at Novosibirsk region, near Kupino, USSR, *c.* 54° 22′ N., 77° 18′ E., *c.* 4930 km. north of Madras	do.

The five birds marked with asterisks were ringed in the course of the BNHS/WHO Bird Migration Field Project. The 3 wagtails are from the lot of 20,300 odd ringed by the BNHS field party in Kerala between December 1962 and February 1963. The recovery of the Forest Wagtail in the Chin Hills is of particular interest since we know even less about its movements than of other migratory wagtails. It is a species that normally breeds in NE. Asia. Nesting has also been reported in the N. Cachar Hills of Assam but doubts have been cast on this report. Its migration route/s to and from SW. India and Ceylon is/are unknown. The speculation is that this wagtail either follows the Eastern Ghats or goes partly over the Bay of Bengal via the Andamans.

It is a question whether the ringed bird had arrived at its destination in the Chin Hills or how much further it still had to travel to its breeding grounds. The reporter states that it was shot by a boy with a catapult, and that it was by itself and not in a party.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6-WB,
May 27, 1963.

EDITORS

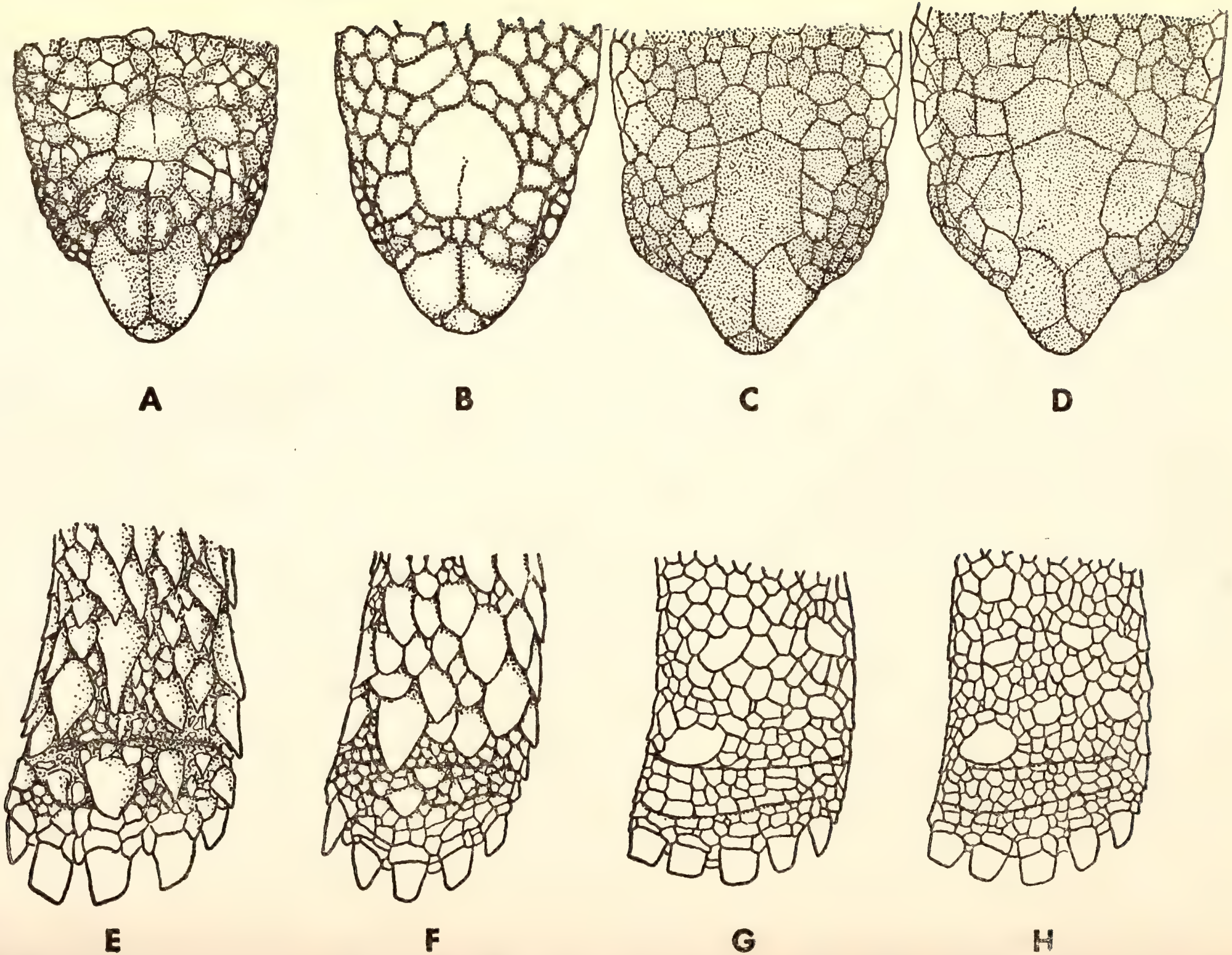
11. *TESTUDO HYPSELONOTA* BOURRET REFERRED TO *GEOCHELONE RADIATA* (SHAW)

(*With a plate*)

While working on the preparation of a checklist of Recent and fossil land tortoises of the world the validity of the Recent species *Testudo hypselonota* Bourret was investigated. This contribution is the result of that short study.

Bourret (1941) described a presumably new species of Recent land tortoise on the basis of a single specimen in the Botanical Gardens of Saigon, to which he gave the name of *Testudo hypselonota*. Bourret stated quite clearly that the exact origin of the specimen was unknown, and that it is not even certain that it was found in Indochina. " Malheureusement l'origine exacte de cette Tortue, provenant d'un Chinois de Cholon qui l'avait lui-même achetée au marché de cette ville, n'est pas connue, et il n'est pas certain qu'elle ait été trouvée en Cochinchine."

Unfortunately, more recent authors, such as Wermuth & Mertens (1961), have failed to recognize the questionable Indochinese origin of the specimen, and have assumed that only the exact locality was unknown. " Verbreitung: Indochina (nähere Fundort-Angaben liegen nicht vor). . . , Terra Typica : Cholon ?" (p. 213).



The scalation of the top of the head (A-D) and the antebrachium (E-H) of four specimens of tortoises

A and E. *Geochelone elegans*, Mt. Abu, Gujarat State, India, WA 350; B and F. *Geochelone platynota*, 'Burma', Zool. Surv. India'; C and G. Holotype: *Testudo* (= *Geochelone*, in part) *hypselonota*, Chelon, Ecuador (?) (in error); D and H. *Geochelone radiata*, 'Western Madagascar', WA 451.

Bourret distinguished *Geochelone* (as *Testudo*) *hypselonota* from the two somewhat similar Asian species, *Geochelone elegans* and *Geochelone platynota,* on the following characters: from both species by (1) the presence of a nuchal scute, (2) the absence of a scale or spur at the tip of the tail, and (3) the colour of the upper part of the head—black in *G. hypselonota* and light in the other two. In addition, it differs from *G. elegans* by (1) the absence of tubercles or spurs on the heel and on the back of the thigh, (2) the small number of yellow rays on the scutes of the carapace, and (3) the presence of a frontal and two rather distinct prefrontals. It differs from *G. platynota* by the plastral pattern as well.

In his description Bourret states that the shell of this tortoise is particularly bombous, and that its sides are inclined inwards below; the large, single supracaudal scute is convex; the mandibles are feebly denticulated, and the upper jaw is bidentate at the front. He states that *G. hypselonota* closely resembles *Geochelone radiata* of Madagascar, but that the former is much more elongate.

Wermuth & Mertens place *Geochelone hypselonota* close to *G. radiata* in their key (p. 187), separating it from the latter on the basis of a presumed flattening of the middle of the carapace, and that the outer surface of the front leg is supposedly covered with small scales in *G. hypselonota* and large scales between smaller ones in *G. radiata.*

All the presumed diagnostic characters given by Bourret and by Wermuth & Mertens, as well as several additional ones, are commented upon below in an attempt to clarify the relationship of *G. hypselonota* to the three similar species, *platynota, elegans,* and *radiata.*

Nuchal scute. Absent in *platynota* and *elegans,* present in *radiata* and *hypselonota.*

Tubercles on thigh. Present in *platynota* and *elegans,* absent in *radiata* and *hypselonota.*

Terminal tail spur. Present in *platynota* and *elegans,* absent in *radiata* and *hypselonota.*

Second costal shape. Same width dorsally and ventrally in *platynota* and *elegans,* wider dorsally than ventrally in *radiata* and *hypselonota.*

Heel scales or spurs. Usually enlarged in *platynota* and *elegans,* never enlarged in *radiata* and *hypselonota.*

Inguinal scute. Relatively small in *platynota* and *elegans,* relatively large in *radiata* and *hypselonota.*

Position of the femoro-abdominal sulcus. Distance to hypo-xiphiplastral suture less than anal length in *platynota* and *elegans,* distance to hypo-xiphiplastral suture equals anal length in *radiata* and *hypselonota.*

Shape of the pleural bones. Not noticeably alternately wider and narrower distally in *platynota* and *elegans,* noticeably alternately wider and narrower distally in *radiata* and *hypselonota.*

Supracaudal scute. Dorsal width almost equal to ventral width of 1st suprapygal in *platynota* and *elegans,* dorsal width much less than ventral width of the 1st suprapygal in *radiata* and *hypselonota.*

Head scalation. Essentially the same in all four described species (Plate, fig. A-D).

Head coloration. Each scale on the top and sides of head usually with a light centre and black or brown border in *platynota* and *elegans,* black on top, sharply set off from white or yellowish sides in *radiata* and *hypselonota* (Plate, fig. A-D).

Number of costal scute rays. The number of rays on the scutes of the carapace of these species is not significant. The number of rays in *radiata, platynota,* and *hypselonota* are relatively few. Within *elegans* there seems to be a north-south cline, in which specimens from northern India have proportionately more rays on each scute than those from southern India and Ceylon.

Plastral pattern. Though the ventral coloration and pattern are variable in all three of the valid species with which *hypselonota* is compared, the basic pattern is the same. A series of black or brown rays of varying thickness diverge from the edges of the juvenile areoli. The widest back rays are always found in the anterior and/or posterior edges of the plastral scutes.

Shell shape. Bourret (p. 9) and Wermuth & Mertens (p. 187) refer to the presumed differences in shell shape between *hypselonota* and *radiata.* Bourret describes the shell of the type and only known specimen of *hypselonota* as bombous, and like that in *radiata,* except that the shell is narrower. His illustration clearly shows the almost even convexity of the carapace of the type, with the central areas of each scute only slightly raised. However, Wermuth & Mertens state that the middle of the shell is flattened in *hypselonota,* and their accompanying figure (p. 213) would indicate that the anterior portion rises quite abruptly. Bourret's illustration is clearly more carefully done in many details (width of the shell compared to its length, shape of the inguinal scute, coloration of the head, etc.). The presumed difference in convexity of the shell of *hypselonota* and *radiata* is not valid.

Bourret states that the shell of *hypselonota* is narrower than that of *radiata*. Ratios of the height of the shell compared with the greatest width of 23 specimens of subadult and adult *G. radiata*, 18 in my own study collection and data for 5 additional specimens taken from Vallant & Grandidier (1910), show considerable variation (height/greatest width shell = 0.74-0.79). This variation includes the ratio Bourret cites for the single specimen of *hypselonota* (0.79). The character will not separate the two species.

Forelimb scalation. *Geochelone radiata* possesses several large, flat scales between many smaller ones on the external surface of the front limbs. Wermuth & Mertens state (p. 187) that the forelimbs of *hypselonota* possess only small scales. Bourret's illustration (pl. 1, fig. *e*) clearly shows several enlarged scales between the smaller ones. Furthermore, the larger ones are in the same position, and of the same shape as those found in *radiata* (Plate, figs. E-H).

SUMMARY

In view of (1) the unknown type locality of *Geochelone hypselonota* (Bourret), (2) the circumstances in which it was obtained, (3) no additional Indochinese specimens have been secured, (4) and the fact that it cannot be separated from *Geochelone radiata* on any single or combination of characters, *G. hypselonota* is placed in the synonymy of *G. radiata*.

ACKNOWLEDGEMENTS

I would like to thank the Bombay Natural History Society, and Mr. M. N. Acharji, Zoological Survey of India, for making the land tortoises in their institutions available to me for study. I also wish to thank the United States National Science Foundation without whose financial assistance (NSF G-17613) it would have been impossible to continue my studies on the systematics of Recent and fossil tortoises.

UNIVERSITY OF COLORADO,
BOULDER,
COLORADO, U.S.A.,
April 3, 1963.

WALTER AUFFENBERG

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12. NOTES ON THE RED COTTON BUG (*DYSDERCUS CINGULATUS* FABR.)

I must confess to a certain amount of surprise on reading Mr. McCann's record of *Calotes versicolor* and *C. rouxi* as major predators of the Red Cotton Bug (1962, *J. Bombay nat. Hist. Soc.* **59**: 680).

Apart from the fact that the genus *Dysdercus* are almost perfect text-book illustrations of an aposematic insect, an East African species, considerably less striking in colour than *D. cingulatus*, is definitely distasteful to toads, which I have always considered as the least discriminating of reptilian and amphibian insectivores. The *Dysdercus* visits my mercury vapour lamp in small numbers and is almost always avoided by the attendant toads, but occasionally, perhaps due to the colour changes caused by the light, one is caught and is then invariably spat out and the inside of the mouth scraped by the forelegs with every appearance of disgust.

P.O. BOX 5026,
MOMBASA,
EAST AFRICA,
January 11, 1963.

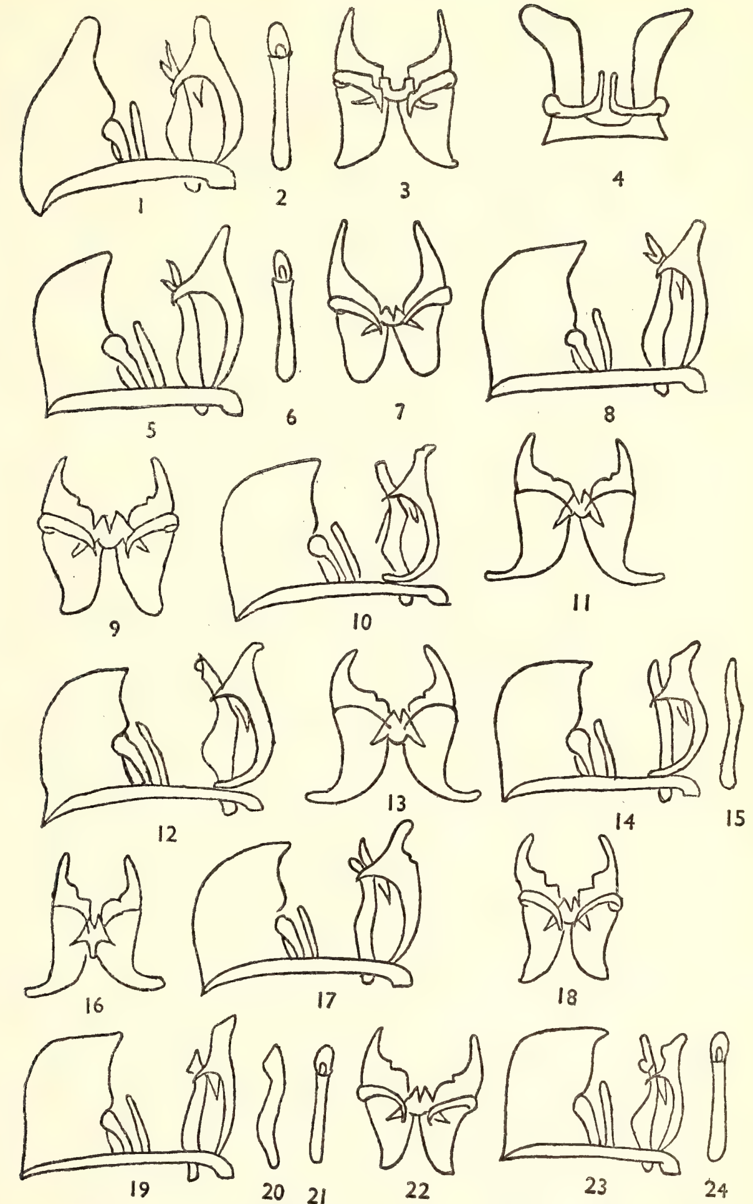
D. G. SEVASTOPULO, F.R.E.S.

13. GENITALIA OF THE BUTTERFLY GENUS *SPINDASIS* WALLENGREN

(*With a plate*)

The drawings on the plate are as follows:

Figure (1) Armature of *syama peguanus*; (2) ventral aspect of its aedeagus; (3) inside of its clasps; (4) diagrammatic view of inside of the uncus of *syama* but representing all the species; (5-7) *lohita himalayanus*; (8-9) *vulcanus fusca*; (10-11) *elima*; (12-13) *ictis*; (14-16) *nubilus*; (17-18) *gabriel*; (19-22) *schistacea*; (23-25) *nipalicus* both ssp. *sani* and *nipalicus*; (26-28) *maximus*.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Genitalia of butterfly genus *Spindasis* Wallengren

Uncus. There is no back, only the two sides. Fig. 4 gives an interior view, actually of *syama* but it serves for all species. The sides are pressed open to about 30 degrees so their shape at this angle is quite unlike their real shape. This is seen in the figures of armatures, 1, 5, 8, etc.

Shape of uncus. All species have the same shape except *syama* (1) tip produced, *lohita* (5) tip broad, *maximus* (26) back twice incurved with tip produced and rather pointed.

Clasps. Side view. As drawn but the tip of *elima* (10) though correctly drawn like an inverted foot with a heel, has in reality the heel so small that close attention is needed to distinguish it from *ictis.*

Inside of clasps. All are figured from the inside but *maximus* from the outside also (fig. 27). The tips (styles) as figured are really the inside edges of the clasps and a little of the interior. They are all drawn to one shape but in *maximus* there is such a curve that the inside edge appears folded over and has been so drawn (28).

The points to be observed are as follows:

a. The slope from the tip to the shoulder where it joins the ventral edge is smooth in *syama* (3) and *lohita* (7) and wavy in *maximus* (27, 28) but with a step in all others, the step being very steep in *gabriel* (18).

b. The shoulder may be right angled as in *syama* (3) and *gabriel* (18) or sloping as in *lohita* (7). The shoulders of the rest are rounded, some perhaps more abruptly curved than others but this is hard to judge. Differences in the figures are due to imperfect drawing.

c. The base of the clasp may have an extension alongside the vinculum to a slender point of attachment to it at the end (11, 13, 16, 25).

d. After removal of the aedeagus the arms which embrace it can be seen. They are broad in fig. 3, 7, 9, 18, 22. In *syama* (3) they are excavated where the end of the arm turns down sharply. Where arms are broad they have been drawn shorter than in reality, so that a gap in the centre can show the bridge joining the clasps. The arms are narrow in fig. 11, 13, 18, 25, but they expand near the tips, though this is not seen in the figures as only the narrow outside edge of the expansion is apparent to the viewer. The arms of *maximus* were torn when extracting the aedeagus so although figured as very narrow (28) they may not in fact be so. In *maximus* they spring from peculiar sharply triangular bases. There is a thin chitinous membrane from this triangle to the base of the clasp, seen only in this species.

e. Shape of the bridge. The cleft is V-shaped in all except *syama* and *maximus* where it is U-shaped (3, 28). In the centre its bottom is rounded but sometimes two thread-like points emerge from it. They are drawn in the figures of *nubilus* (16) and *nipalicus* (25). They are the edges of the curled membrane supporting the bridge and connecting it to the clasps. In all species a most troublesome non-chitinous membrane covers the arms and spreads across the clasps over the triangular legs of the bridge. It obscures the interior and can only be partially torn away by a dissecting needle, when in liquid. When dry it becomes hard and opaque. Genitalia can be affixed to a card by Durofix and detached by amyl acetate at a future examination.

f. Aedeagus. Distinct in *nubilus* (15), *elima* (10), and *ictis* (12). The others are alike seen ventrally (e.g. 2, 6, 21, 24) but the internal process may project from the edge of the orifice towards the uncus in fig. 1, 5, 8, etc. and be visible from the side view or lie against the back as in *schistacea* (19) and be invisible. The aedeagus of *maximus* has its sides straight and parallel.

Conclusion. If all the above characters of each species are taken together a difference in one or more points will be found from the total characters of any other species. The accepted names therefore are of species really separate and this examination results in nothing original. My own collection is incomplete and I have to thank the authorities of the British Museum (Natural History) for allowing me to examine their collection, but have not requested special permission to dissect rarities. The area treated is that of India, Pakistan, Burma, and Ceylon.

5, Upper Wimpole Street,
London W. 1, KEITH CANTLIE
May 24, 1963.

14. PARASITIZING OF COMMON FRESHWATER TURTLE *LISSEMYS PUNCTATA PUNCTATA* (BONNATERRE) BY THE COPEPOD *ARGULUS INDICUS* WEBER

On 10 December 1956 a specimen of the common freshwater turtle *Lissemys punctata punctata* (Bonnaterre) was collected from Gokalpur Lake, Jabalpur (M.P.), in a throw net along with several species of fish. The turtle was kept aside as a side collection since the netting was intended for the investigation of the fish fauna. Later, on a closer examination of the turtle on its ventral side, some parasites, subsequently identified as *Argulus indicus* Weber, were observed at the basal portion of the anterior pair of appendages and attached to the skin of the plastron. The fact that these parasites make use of the aquatic turtles as hosts is not unexpected, though so far unrecorded.

Argulus indicus Weber has been previously recorded in India from *Ophicephalus punctatus* Bloch by Ramakrishna (1951) and from *Ophicephalus* (*Chana*) *gachua* H.B. by the author in 1958.

The genus *Argulus* though primarily ectoparasites of fishes are also found on other aquatic vertebrates. An American species *A. americanus* has been reported from the Salamander *Pseudobranchus striatus axanthus* and a tadpole of the frog *Rana heckscheri* Wright by Goin & Ogren (1956).

The author is thankful to Dr. B. S. Chauhan, Superintending Zoologist, Zoological Survey of India, Calcutta, for the specific identification of the parasites.

DEPARTMENT OF ZOOLOGY,
GOVERNMENT COLLEGE, R. B. MALAVIYA
SHAHDOL, M.P.,
May 17, 1963.

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15. ON THE OCCURRENCE OF THE LEECH *OZOBRANCHUS BRANCHIATUS* (MENZIES 1791) (HIRUDINEA) IN INDIA (GULF OF KUTCH)

(*With three text-figures*)

Ozobranchus shipleyi Harding 1927, *O. papillatus* Kaburaki 1921, and *O. polybranchus* Sanjeeva Raj 1954 are the only three species of genus *Ozobranchus* recorded from India so far.

On 2 October 1962 the authors collected a few specimens of *Ozobranchus* from the plastron of a live turtle on the coast of Piroton

Island, Gulf of Kutch. Fifteen preserved specimens were studied and identified as *Ozobranchus branchiatus* (Menzies). Earlier records of this species are from the tropical Pacific, Flanders, Australia, and Florida (Raj 1954). This is the first record from India.

The live specimens were creamy white in colour. The length of the specimens studied varies from 5 to 11 mm.; the maximum width of the body (excluding the gill) is 4 mm. The body is divisible into an anterior narrow part, the neck, and a posterior broad abdomen. Somites one to three are represented by the first two rings (Text-fig. 1). The succeeding twenty-three somites, from the fourth to the

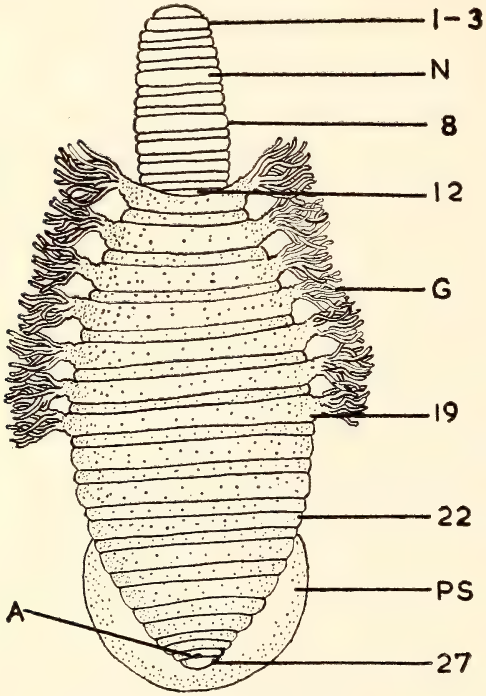

FIG.1.

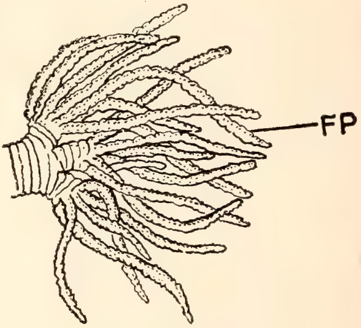

FIG2.

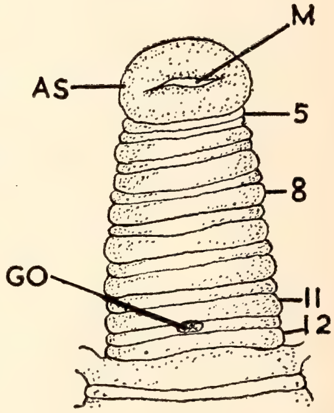

FIG.3.

Fig. 1. Entire specimen *Ozobranchus branchiatus* × *c.* 8 ; Fig. 2. A single gill ; Fig. 3. *O. branchiatus* : anterior region (ventral view)

A. anus ; AS. anterior sucker ; FP. finger-like process ; G. gill ; GO. genital opening; M. mouth; N. neck ; PS. posterior sucker. The numbers denote the somites.

twenty-sixth, are bi-annulate, the anterior ring being wider. The twenty-seventh somite is uni-annulate. In all the specimens the eyes are not visible externally. The anterior sucker (Text-fig. 3) is not prominent; it carries the mouth and is directed ventrally. The posterior sucker (Text-fig. 1, PS) is large and as wide as width of the body. There are seven pairs of gills on the anterior seven abdominal somites, the larger ring of the somite bearing the gill. Each gill (Text-fig. 2) is divided into two to three branches bearing finger-like processes. The number of these finger-like processes in each gill varies from thirteen to twenty-one in a single specimen. It is observed that the finger-like processes are more in number in the anterior gills. The remaining eight somites of the abdomen are without gills.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. A. K. Datta Gupta, Professor of Zoology, for his valuable suggestions. Thanks are also due to Dr. B. N. Desai, Fisheries Research Officer, Jamnagar, for his help in the collection.

DEPARTMENT OF ZOOLOGY,
BIRLA COLLEGE,
PILANI,
RAJASTHAN,
April 23, 1963.

J. M. GHOSH
PEACE JOHNSON
C. K. G. NAYAR

[The turtle from which the specimens reported were collected was released and its identity is not certain. This species of leech has so far been recorded only from *Chelonia mydas* (Linn.), the Green Turtle.—EDS.]

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16. NEW HOST PLANTS FOR *DENDROPHTHÖE FALCATA* (LINN. F.) ETTING. AT PAVAGADH

Recently[1] V. Ravindra Nath & V. L. Narasimha Rao (1959), in their paper 'Additional Hosts for Flowering Parasite, *Dendrophthöe falcata* (L. f.) Ettingsh. (*Loranthus longiflorus* Desr.)', have brought together all the scattered data on the subject from different parts of India thus putting before the readers an up-to-date host range of 268 hosts of *Dendrophthöe falcata.*

During the exploration of the flora of Pavagadh for the year 1958-59 we noticed on several occasions *Dendrophthöe falcata* as a parasite on different host plants. This paper reports the attack of *Dendrophthöe falcata* on 5 new host plants, recorded for the first time in India. This brings the host range of *Dendrophthöe falcata* to 273. The host plants noticed are: *Cadaba fruticosa* Druce, *Firmiana colorata* R. Br., *Ailanthus excelsa* Roxb., *Butea monosperma* (Lam.) Taub., and *Tecoma stans* H.B.K.

PAST RECORDS FROM PAVAGADH

Rev. Fr. Santapau (1955) in his paper 'Excursion of the Indian Botanical Society to Pavagadh Hill near Baroda' recorded the parasite as very rare for this type of forest. The plant, in flower and young fruit, was noticed on the following hosts: *Alangium salvifolium, Grewia tiliaefolia, Cassia fistula, Acacia leucophloea.* It seems that, of the four host species recorded above, *Alangium salvifolium* has not been included in the list of host plants recorded in India published by V. Ravindra Nath & V. L. Narasimha Rao; hence, due credit for the new record should be given to Santapau. This raises the host range to 274. It is for the first time that the family Alangiaceae acts as a host for the parasite.

Phatak & Oza (1957-58) in their paper 'Contributions to the Botany of the Pavagadh Hill, Bombay State', under the heading 'Parasites and Epiphytes' recorded four more host plants other than those recorded by Santapau. The hosts noticed were *Salmalia malabarica, Mangifera indica, Cordia dichotoma, Tectona grandis,* all of them recorded for the first time from Pavagadh.

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[1] This note was received in the Society's office in 1961. Its publication was delayed as it went astray in correspondence between the Society and its referee.—EDS.

ANNOTATED LIST OF NEW HOST SPECIES RECORDED FROM PAVAGADH

CAPPARIDACEAE

1. **Cadaba fruticosa** Druce

It is for the first time that the genus *Cadaba* is reported as a host for this parasite.

STERCULIACEAE

2. **Firmiana colorata** R. Br.

The parasite has attacked a new species in the genus *Sterculia sensu lato.*

SIMAROUBACEAE

3. **Ailanthus excelsa** Roxb.

This is the first time that the family Simaroubaceae has been connected with this parasite. About 54 plant families have been recorded as being parasitized by *Dendrophthöe falcata*; the family Simaroubaceae is an addition to the previous records.

PAPILIONACEAE

4. **Butea monosperma** (Lam.) Taub.

This is the first report that the genus *Butea* has been attacked by this parasite.

BIGNONIACEAE

5. **Tecoma stans** H.B.K.

The range of host species in the genus *Tecoma* is hereby extended.

DEPARTMENT OF BOTANY,
M.S. UNIVERSITY,
BARODA,
June 12, 1963.

A. R. CHAVAN
G. M. OZA

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17. HOSTS OF *DENDROPHTHÖE FALCATA* (LINN. F.) ETTINGSH. IN THE NATIONAL BOTANIC GARDENS, LUCKNOW

Dendrophthöe falcata (Linn. f.) Ettingsh. (fam. Loranthaceae) is a destructive semi-parasite occurring on a large number of plants of economic importance. B. Singh [1962, Studies in Angiospermic Parasites. No. 1. *Dendrophthöe falcata* (L. f.) Ettingsh., its life-history, lists of hosts and control measures. *Bulletin of the National Botanic Gardens* No. 69] gave a list of 319 host species from all over India. He accepts that his list is not a final one as the observations are only casual, and that an intensive survey might yield many more host plants. With this suggestion of Singh in view, a survey was made in the National Botanic Gardens, an area of about 80 acres (*c.* 32 hectares). This revealed a large number of hitherto unrecorded hosts; an intensive survey throughout the country therefore appears advisable.

The complete list of hosts from and near the National Botanic Gardens is given below, the location of the plant being given within parenthesis. The host species that are new records for India are marked with an asterisk:

*****Acacia lenticularis** Buch.-Ham. (Central Lawn).
Achras sapota Linn. (Botany Plot).
Aegle marmelos (Linn.) Correa (Am-bagh Road, Gokhale Marg).
Albizia lebbek Benth. (West Lawn, New Building).
Annona squamosa Linn. (Nursery).
Anogeissus latifolia Wall. (Medicinal Plot).
Bauhinia purpurea Linn. (Am-bagh Road).
Bauhinia variegata Linn. (West Lawn).
Callistemon lanceolatus DC. (Am-bagh Road).
*****Casuarina glauca** Sieber (Botany Plot).
Casuarina equisetifolia Forst. (South of Rosarium).
Cassia fistula Linn. (West Lawn).
Cassia siamea Lamk. (Arboretum).
Celtis australis Linn. (Nursery Road).
*****Celtis sinensis** Pers. (Carlton Hotel).
Chloroxylon swietenia DC. (Nursery Road).
Ficus lacor Buch.-Ham. (near Stadium).
Ficus religiosa Linn. (Rana Pratap Marg).
*****Firmiana colorata** (Roxb.) R.Br. (Arboretum)[1].
Garuga pinnata Roxb. (Botany Plot).
*****Gleditschia sinensis** Lamk. (Medicinal Plot).
Gmelina arborea Linn. (Nursery).
Grevillea robusta A. Cunn. (Nursery).
Holoptelea integrifolia Planch. (Ashok Marg).

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[1] But see Miscellaneous Note No. 16 above.—EDS.

Kydia calycina Roxb. (Am-bagh Road).
***Lagerstroemia floribunda** Jack. (West Lawn).
***Lagerstroemia flos-reginae** Retz. (Nursery).
Lagerstroemia thorelli Gagnep. (near Workshop).
Mangifera indica Linn. (near Workshop).
***Markhamia platycalyx** Sprague (Am-bagh Road).
Melia azedarach Linn. (Nursery).
***Milletia ovalifolia** Kurz. (Nursery).
Millingtonia hortensis Linn. (Am-bagh Road).
Olea cuspidata Wall. (Botany Plot).
***Olea** sp. (near **O. europea**) (West Lawn).
***Parmentiera cerifera** Seem. (Am-bagh Road).
Pithecellobium dulce Benth. (Woodland).
Saraca indica Linn. (Medicinal Plot).
Shorea robusta Gaertn. (Central Lawn).
Tectona grandis Linn. f. (Tectona Plot).
Terminalia chebula Retz. (Gokhale Marg).
Terminalia muellerii Benth. (Bulb Garden).
***Wrightia coccinea** Sims. (Arboretum).

NATIONAL BOTANIC GARDENS,
LUCKNOW,
June 25, 1963.

J. G. SRIVASTAVA

[It is distressing to read of so many trees in and near the National Botanic Gardens attacked by this parasite. We trust that, now that their attention has been drawn to its presence, the authorities will get the trees examined and cleaned of the pest where necessary.—EDS.]

18. A CONTRIBUTION TO OUR KNOWLEDGE OF *DALECHAMPIA TAMNIFOLIA* LAM.

(*With a plate*)

Dalechampia is a fairly large Euphorbiaceous genus, comprising over 140 species (INDEX KEWENSIS 1893-1940) and mostly distributed in the warmer regions of the globe. According to Bentham & Hooker's classification the genus comes under the tribe Crotoneae and subtribe Plukenetieae. Most of the species are twiners having a pair of conspicuous bracts for the inflorescence. *D. tamnifolia* is indigenous to Madagascar. However, the species has been reported from India by Poivre and specimens of this are found in the herbarium of de Jussieu (Lamarck, 1786). Later in 1875 Lt.-Col. Hobson has recorded this species as occurring in the former Presidency of Bombay. Engler (1919) has described this taxon in DAS PFLANZENREICH. This species was collected from Trivandrum, and it is here reported for the first time from south India.

While studying the morphological characters of *Dalechampia tamnifolia,* it was found that there are a number of important features left out in the original description by Lamarck (1786) and the one by Engler (1919). This necessitated a thorough study of its morphology and revision of the description.

DESCRIPTION

Habit. A twining undershrub with stinging glands all over the plant body, interspersed among the ordinary hairs. Tender portions of the plant are velvety tomentose. *Stem.* Terete and hairy with a massive central core of pith. *Leaves.* Alternate, palmately trilobed, 5-nerved, reticulate, dentate, cordate, acuminate, pulvinate and hairy, lanceolate and with persistent stipules 10-15 mm. long. The leaves are 15-20 cm. long and 5-8 cm. broad and are provided with a pair of scales at the basal notch of the lamina. These scales are smaller than the stipules. There are 3-4 glands usually at the base of the scale at different levels, rarely on the lamina near the scales. *Inflorescence.* Compound, axillary, monoecious, in dense peduncled heads. Often a small leaf is present towards the base of the peduncle. Peduncles 6-12 cm. long, pubescent with a pair of white trilobed bracts 3.5-4.5 cm. long, each one subtending the male and female inflorescence. The leafy bracts are also provided with a pair of stipule-like structures on either side. The bracts later on turn creamy white, yellow, and finally green resembling a leaf, as the fruits ripen. The male and female inflorescences arise from the same level on the peduncle. In the young inflorescence the male flower buds are originally posterior in position. When they grow older and attain a bigger size, the inflorescence axis resupinates bringing the male inflorescence to the anterior position, as the young female flowers are relatively much lighter than the cluster of male flowers. But with the ripening and consequent increase in weight of the fruits, the inflorescence axis again turns through 180°, bringing back the female inflorescence to its original anterior position. *Male inflorescence.* A compound cyme of 16 flowers. There are five cymose bundles of 3 flowers each, and each of these bundles is subtended by a bract, the five bracts forming an involucre. There are also five smaller bracteoles in between the male flowers. The remaining oldest flower of the cluster is centrally located. The flower stalk is jointed slightly above the middle. Perianth lobes are yellow, keeled, 5-7, and valvate. There are 25-40 stamens on a convex receptacle and surmounted on an androphore. Staminal filaments are slightly longer than the anthers, which are basifixed and extrorse. The pollen grains are tricolpate, oblong, 35-40μ broad, 70-75μ long, with thick and rough outer wall. Pistillode is absent. *Female inflorescence.* A simple cyme of 3 flowers, each subtended by a ciliate bract. Anterior bract is slightly larger than the others and is rhomboid. The other two bracts are keeled and 3- or 4-toothed. Perianth 12, pinnatifidly fimbriate, accrescent, green and velvety tomentose. Ovary is tricarpellary, syncarpous, and deeply 3-lobed. Stylar column broader towards the trilobate stigma. Ovules solitary, anatropous, axile, pendulous with ventral raphe. *Fruit.* A capsular schizocarp splitting into 3 one-seeded mericarps which in turn split loculicidally to liberate the seed. *Seed.* 5 mm. in diameter.

COMMENTS

Hooker (1885), Rama Rao (1914), and Gamble (1925) have reported *Dalechampia velutina* Wight as occurring in south India. This species has some resemblance to *D. tamnifolia* Lam. especially in having a staminal column. Therefore it appears worthwhile to compare these two species and to establish their morphological differences. The chief points of variation between the two can be summarised as shown below:

D. velutina Wight	*D. tamnifolia* Lam.
LEAVES	
Velvety-Pubescent beneath. Scales absent at basal notch of lamina. Pulvinus absent.	Sparsely hairy. Leaves are larger and scales present at basal notch of lamina. There are 3-4 glands at base of each of the scales. Pulvinate.
MALE FLOWERS	
Outer perianth 4-lobed. Anthers apiculate.	Outer perianth 5-7. Anthers not apiculate.
FEMALE FLOWERS	
Outer perianth 8-10	Outer perianth invariably 12
STINGING GLANDS	
Absent.	Present all over the plant body.

Thus it is seen that the species under review in this note is *Dalechampia tamnifolia* Lam. A specimen of this taxon is deposited in the Kew Herbarium.

The present observation has elucidated some of the important features quite characteristic of the species unnoticed in previous reports. These include the presence of: (1) stinging glands, (2) glandular structures found at the base of leaf scales and adjacent parts on the lamina, (3) pulvinate leaf, (4) the resupination of inflorescence before and after anthesis, and (5) the characteristic three-chambered pollen grains.

ACKNOWLEDGEMENTS

The author is deeply indebted to Prof. A. Abraham, Head of the Botany Department, University of Kerala, for his keen interest in the work and encouragement. He is also grateful to Dr. H. Santapau Director, Botanical Survey of India, and to Dr. S. K. Mukerjee, National Herbarium, Calcutta, for kindly making available some relevant literature. To the Director, Royal Botanic Gardens, Kew, he is thankful for assistance rendered in determining the species name.

DEPARTMENT OF BOTANY,
UNIVERSITY OF KERALA,
TRIVANDRUM, S. INDIA,
May 24, 1963.

K. J. THOMAS[1]

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Fig. 1. Part of shoot with inflorescences × *c.* ⅙ ; 2. A node showing the persistent stipules and pulvinate petiole (note the origin of leaf petiole from the peduncle) × *c.* ¼ ; 3. Ventral view of lamina (basal region) showing the scales, which possess glandular structures near the base × *c.* 1 ; 4. A stinging gland × *c.* 75; 5. Ordinary hairs × *c.* 75; 6. A compound inflorescence × *c.* ¼; 7. A male inflorescence × *c.* ½; 8. Flower buds of a compound inflorescence bringing out the arrangement of flowers, especially those of the male inflorescence × *c.* ½; 9. One of the five cymes of the male inflorescence with the outer perianth × *c.* ¾ ; 10. Two lobes of the outer perianth of male inflorescence × *c.* ⅝ ; 11. A male flower (note the androphore) × *c.* 1½; 12. Longitudinal section of male flower × *c.* 1½; 13. A perianth lobe of the male flower × *c.* 1½; 14. A stamen × *c.* 6; 15. A tricolpate (3-chambered) pollengrain × *c.* 175 ; 16. A female inflorescence × *c.* ½; 17. Outer perianth of female inflorescence × *c.* ⅝; 18. A female flower showing the fimbriate perianth lobes teased apart × *c.* ⅝; 19. Longitudinal section of pistil × *c.* 1¼ ; 20. Transverse section of ovary × *c.* 1¼; 21. A mature fruit × *c.* ½ ; 22. A seed showing the ventral raphe × *c.* ⅝.

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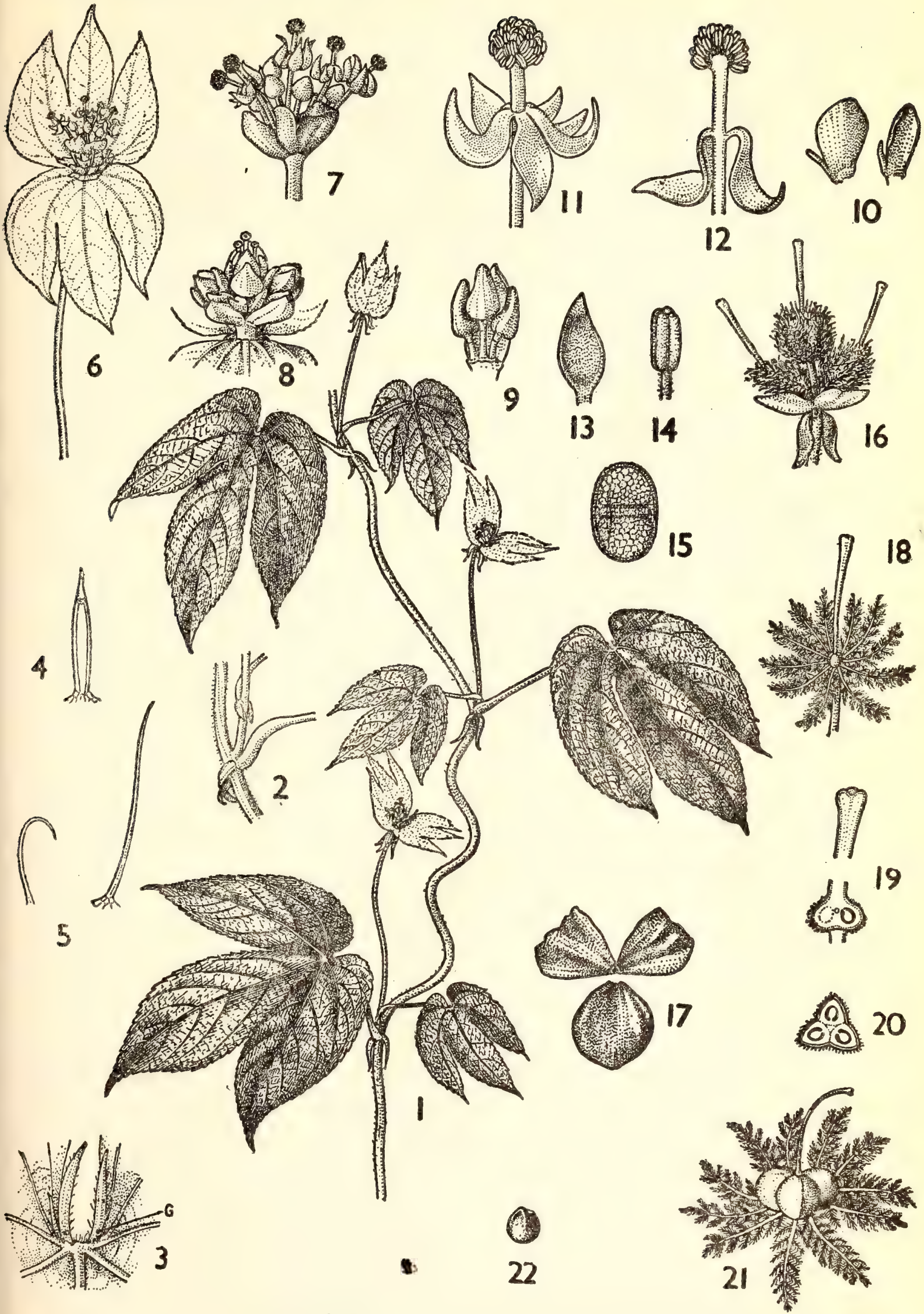
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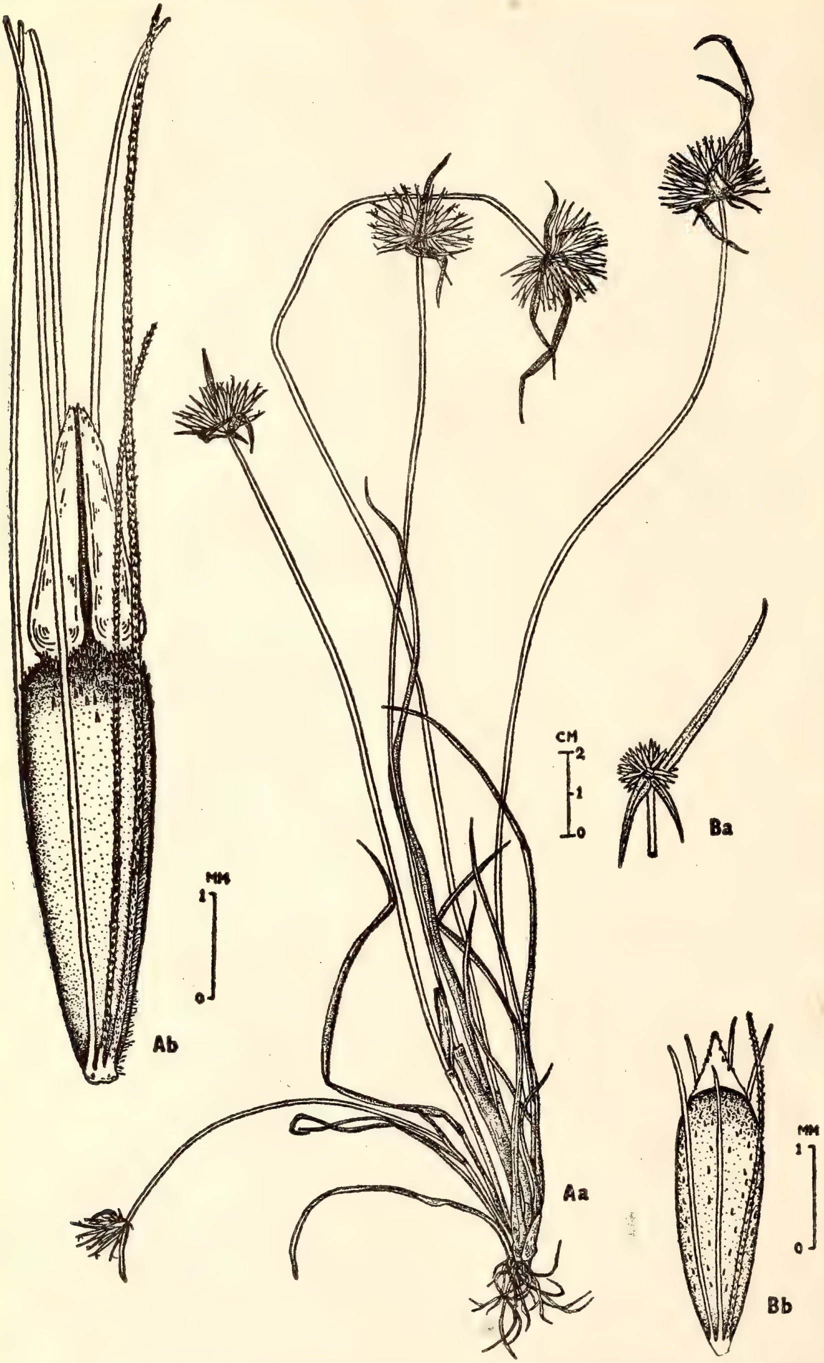
Dalechampia tamnifolia Lam.
For explanations see page opposite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A. *Rhynchospora longisetis* R. Br.: Aa. The whole plant; Ab. Nut (vesture shown only in two bristles). B. *R. wightiana* Steud.: Ba. Head; Bb. Nut (vesture shown only in one bristle)

19. A NOTE ON THE OCCURRENCE OF *RHYNCHOSPORA LONGISETIS* R. BR. IN INDIA WITH SOME INTERESTING OBSERVATIONS

(*With a plate*)

Among the species of *Rhynchospora* Vahl mentioned by Clarke (1 *a*) in Hooker's FLORA OF BRITISH INDIA, *R. longisetis*—an Australian species—is known to extend westwards up to Burma only. Recently this species has been collected from the Ramtek Forests (79° 20′ E., 21° 24′ N.) situated about 28 miles (*c.* 45 km.) north-east of Nagpur (Maharashtra). A perusal of the pertinent literature reveals that about 20 years after the publication of Clarke's treatment of the Cyperaceae in the above work, Graham (2 *a*) recorded its occurrence for the first time at the 'Jubbulpore Farm', Jabalpur (Madhya Pradesh), which lies about 135 miles (*c.* 217 km.) north-east of Ramtek. It will be worthwhile to mention here that Graham (2 *b*), in his paper on the vegetation of Ramtek based on the collection made in September 1912, does not report the occurrence of this interesting species in that area. It is, therefore, quite probable that at the time of his recording this species, it was more or less restricted to the above Farm only. After Graham, it was again reported by Raizada (3) from Banda (South Banda, U.P., 15-10-1921, *Sri Ram*), a station about 150 miles (*c.* 240 km.) north-east of Jabalpur. Since the occurrence of *R. longisetis* has not been reported west of the limits of its natural geographic distribution except from the above-mentioned localities, one is inclined to believe that it got introduced at the Farm accidentally. During this period of about 50 years, the present species has obviously spread to a considerable area between Jabalpur and Ramtek, as our field notes show that it is very common in moist situations at Ramtek Hill Forests. It is not very unlikely that it may be occurring in the adjoining areas also.

On a critical examination of the material at our disposal, certain discrepancies in the account of *R. longisetis* given by Clarke in Hooker's FLORA have been noticed. For example, he does not mention that out of the six hypogynous bristles, one is comparatively more slender and much shorter than the rest, which is an important constant character for the above species. This fact has been corroborated in a communication to us by Dr. J. H. Kern, who has had access to authentic material of *R. longisetis* from various localities as well as to the type. Further, Clarke mentions for the species that the bristles '. . . in the upper half all are simply scabrous with teeth pointing upwards, in the lower half the 3 inner (petals) are nearly glabrous, the 3 outer (sepals) densely plumose'. But in the material examined by us—including a sheet from Calcutta Herbarium (Burma, Karen Country, *S. Kurz*) determined by Clarke—the shorter bristle is antrorsely barbed throughout its length, whereas the remaining 5 are antrorsely barbed only in the upper half and plumose in the lower region; one of the longer bristles may be almost glabrous at the very base.

Apart from the above-mentioned differences, it has been found that the figure of the nut of *R. longisetis* given in Clarke's (1 *b*) ILLUSTRATIONS OF CYPERACEAE (t. 65, f. 2) is inaccurate, as all the bristles have been shown of almost equal length and the slender nature of the sixth bristle remains unaccounted for. Besides, the shape of the beak of the nut also has not been correctly depicted. Hence, the present illustration of *R. longisetis* showing its habit and the correct details of the nut is being provided. The head and nut of *R. wightiana* Steud. have been illustrated, too, for comparison in the size of their heads and chiefly in the details of the mature nuts of these two species which superficially resemble each other.

The figures of these two species have been drawn from the following sheets:

R. longisetis—INDIA, Nagarjun Hill Forests, Ramtek, Maharashtra, 18-10-1959, *K. M. Balapure* 70606, sheet no. 48705 (LWG); *R. wightiana*—Wight 2911 (CAL).

We are grateful to our Director, Prof. K. N. Kaul, F.L.S., for giving us facilities for work and for going through the manuscript. Our thanks are also due to the Chief Botanist, Botanical Survey of India, for the loan of the herbarium sheets, and to Dr. Kern of Rijksherbarium, Leiden, for confirming the identification and for his valuable comments.

HERBARIUM,
NATIONAL BOTANIC GARDENS,
LUCKNOW 1,
April 19, 1963.

S. L. KAPOOR
V. S. SHARMA
(MRS.) S. CHOPRA

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2b. Graham, R. J. D. (1913): Notes on a collecting tour at Ramtek, C. P. *J. Bombay nat. Hist. Soc.* **22**: 236-241.

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20. NOTES ON SOME BOMBAY PLANTS

After an intensive exploration of various areas in the neighbourhood of Bombay, this note is prepared to add to the present knowledge of our Bombay plants. In the text, references to the specimens in Blatter Herbarium are given with the collector's names and numbers.

CAPPARIDACEAE

Cleome burmanni W. & A. Prodr. **1** : 22, 1834; Cooke, Fl. Pres. Bom. **1** : 39, 1901; Blatter in J. Bom. nat. Hist. Soc. **31** : 899, 1927.

A rare plant, noted only once along roadsides in Malad, Salsette Island, Bombay, in July 1954. The author's collection (*Shah* 7117) is the only sheet of this species in Blatter Herbarium. A distinct species in the genus *Cleome*, easily recognised by the violet-purple flowers.

Cooke and Blatter give locality Hyderabad (Sind); the latter author, however, is doubtful of the occurrence of this plant there. *Cleome burmanni* seems to be recorded for the first time for Bombay by Graham in his CATALOGUE 7, 1839; since then it appears not to have been reported from erstwhile Bombay State by any other worker except the author.

The author is deeply thankful to Dr. S. K. Mukerjee, Keeper of the Central Herbarium, Calcutta, for confirming the identification.

POLYGALACEAE

Polygala chinensis Linn. Sp. Pl. 704, 1753; Cooke **1** : 60, 1901. *Polygala arvensis* Willd., Dalzell & Gibson, Bom. Fl. 12, 1861.

A fairly common plant during the monsoon in grass fields and on grassy slopes, generally in rocky ground. In general habit and in yellow flowers, it is similar to some species of *Crotalaria* with which it is confused; the flowers and fruits, however, are typical.

According to Dalzell & Gibson, Gamble (Fl. Madr. **1** : 57, 1915), Saxton & Sedgwick [*Rec. Bot. Surv. Ind.* **6** (7) : 245, 1918], Santapau (*Journ. Guj. Res. Soc.* **16** : 300; FL. PURANDHAR 21, 1958) the flowers are yellow. Mukerjee (*Bull. bot. Soc. Beng.* **12** : 35, 1958) states that they are yellowish green. Cooke describes: 'Flowers yellow, fading pink.' Haines (Bot. Bih. & Oris. 40, 1921) states the flowers are green or 'when young yellow, fading to pink (C. B. Clarke)'. In the vicinity of Bombay, the flowers are yellow only.

Dalzell & Gibson, and Saxton & Sedgwick give the flowering season July-August, whereas, according to Cooke, it is October-March. The latter seems to be incorrect at least for our Bombay plants. In Bombay, this is one of the first plants to appear soon after the onset of the monsoon and it disappears by the end of the rainy season. The sheets of *P. chinensis* L. in Blatter Herbarium, collected from many parts of erstwhile Bombay State, also indicate the flowering and fruiting seasons between July and October.

MALVACEAE

Abutilon ramosum (Cav.) Guill. Perr. et A. Rich. Fl. Senegamb. **1** : 68, 1830; Cooke **1** : 98, 1901.

Blatter (*J. Bombay nat. Hist. Soc.* **34** : 630, 1930) adds localities Cutch and Bombay to those given by Cooke. In Blatter Herbarium there are sheets of *A. ramosum* from Cutch, Saurashtra, Ahmedabad, Cambay, Bàroda, and one sheet (No. 13846, without collector's name) from Parel (Bombay) collected in February 1917; the latter seems to be near *A. indicum* (L.) Sw. In my opinion, *A. ramosum* does not occur in the vicinity of Bombay. The axillary and terminal, trichotomously branched, pedunculate cymes, small size of the fruits, and 8-10 distinctly mucronate carpels are typical of this plant and render it easy for identification.

PAPILIONACEAE

Alysicarpus hamosus Edgew. in Journ. Asiat. Soc. Beng. **21** : 171, 1853; Cooke **1** : 346, 1902. *Hedysarum procumbens* Roxb. Hort. Beng. 56, 1814 (nomen), & Fl. Ind. **3** : 345, 1832 (non Mill. 1768).

According to Cooke this is a rare plant. This does not seem to be correct; it is fairly common in Bombay and its neighbourhood during the monsoon along roadsides, railway lines, in undergrowth on hills, in grass fields, and occasionally on sandy shores, in loose or dense patches. It is also common at Baroda and Broach and according to Santapau (FL. SAURASHTRA **1** : 147, 1962) in various parts of Saurashtra.

Desmodium gangeticum (L.) DC. Prodr. **2** : 327, 1825; Cooke **1**: 356, 1902.

This is one of the commonest plants of Bombay during the post-monsoon period. In most of the Indian floras it is described as

30-60 cm. tall. Judging from the remarks on the sheets of this species in Blatter Herbarium and from my own observations, it is generally 30-60 cm. tall, occasionally up to 150 cm., rarely 180-195 cm. high (*Shah* 10446; *Tavakari* 1766).

On the Karjat hills, the author noted 180-195 cm. tall plants in a patch of *Apluda mutica* L. which itself was about 180 cm. tall.

APOCYNACEAE

Rauvolfia tetraphylla Linn. Sp. Pl. 208, 1753; Rao in Ann. Miss. Bot. Gard. **43** : 285, 1956. *Rauvolfia canescens* Linn. Sp. Pl. (ed. 2) : 303, 1762; Cooke **2** : 128, 1904.

A native of West Indies, reported for the first time in India, probably by Voigt (HORT. SUB. CAL. 532, 1845). Dalzell & Gibson (BOM. FL. SUPPL. 53, 1861) describe it and state that it was raised from Calcutta seeds at Hewra and Dapoorie. In Bombay, it is occasionally cultivated in gardens. As a weed it is rare, collected from Sewri hills (*Acland* 679), Thana (*Fernandez* without number), Mazagaon (*Fernandez* 4200), and National Park, Borivli (*Shah* 10565). At Baroda, especially in the University Campus, this has been found running wild (*Shah* 564, 1496-98; *Irani* 561, 1981-83).

BORAGINACEAE

Heliotropium marifolium Retz. var. **laxiflorum** (Roth) Cooke, Fl. Pres. Bom. **2** : 213, 1904. *Heliotropium laxiflorum* Roth; Dalzell & Gibson, Bom. Fl. 171, 1861.

Dalzell & Gibson give the locality Worli hills (near Bombay); Cooke states that he has not seen any specimen of this plant from Bombay Presidency. In the neighbourhood of Bombay, however, it is a fairly common plant among grasses during the rainy season, but is often missed because of its size, only 5-10 cm. tall, and minute, white flowers.

SCROPHULARIACEAE

Peplidium maritimum (L. f.) Wettst. in Pfam. **4** (3 *b*) : 78, 1895. *Peplidium humifusum* Delile: Cooke **2** : 299, 1905.

A rare plant, so far found only along sea-side at Bandra (*Vakil* 31247) and on Madh Island in rice fields during monsoon (*Santapau* 21304; *Shah* 7623, 7804, 7952). In Blatter Herbarium, there are a few sheets from other parts of erstwhile Bombay State (Kumta, *Saldanha* 6621-3, 8446-48; Karwar, *Sedgwick* 6751; Saurashtra, *Santapau* 16760). There is one sheet from Mahableshwar (*Nana* 7300) wrongly identified as *P. humifusum*; it is *Glossostigma spathulatum* W. & A.

Striga gesneroides (Willd.) Vatke ex Engl. Abhandl. Preuss. Akad. Wiss. 28, 1894. *Striga orobanchioides* Bth. : Cooke **2** : 302, 1905.

In many parts of Bombay State the common host for this root-parasite is *Lepidagathis cuspidata* Nees. It is also found on some other hosts, e.g. *Lepidagathis trinervis* Nees (Dwarka, *Santapau* 16592), *Lepidagathis prostrata* Dalz. (North Kanara, *Hall. & McCann* 34177), *Euphorbia neriifolia* L. (Anand, *Saldanha* 1647-51), and *Nicotiana tabacum* L. (Ahmedabad, *Shah* 10612).

AMARANTHACEAE

Cyathula prostrata (L.) Blume, Bijdr. 549, 1825; Cooke **2** : 496, 1906.

Dalzell & Gibson (BOM. FL. 219, 1861) and Cooke describe this plant without giving any locality; the latter author remarks 'Rare, Stocks without locality in Kew Herbarium.'

In the vicinity of Bombay this is a rare plant only found at Ghodbunder (*Sedgwick*, without number; *Shah* 10482-83). It is also collected from North Kanara (Castle Rock, *Fernandez* 462; Supa, *Sedgwick* 4864; Yellapur, *Sedgwick* 3133; Karwar, *Hall. & McCann* 34800; *Sedgwick & Bell* 6585).

ST. XAVIER'S COLLEGE,
BOMBAY 1,
January 21, 1963.

G. L. SHAH, M.SC., PH.D.

21. FORTY-SEVEN MORE GRASSES FROM LUCKNOW

Patil (1960)[1] reported the presence of 39 grass species from Lucknow. During the course of a survey of the vegetation of Lucknow district (1961-1962), the author toured round the whole district in all seasons of the year and collected many grasses, which have not been reported by Patil. Most of these grasses are quite common in and around Lucknow town.

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[1] Patil, R. P. (1960) : A key to the genera of the common grasses of Lucknow and its environs. *Proc. Indian Acad. Sci.* **51** (B) : 122-132.

The list is given below; the areas whence the species have been collected are also mentioned:

Alloteropsis cimicina (Linn.) Stapf in Prain, Fl. Trop. Afr. 9 : 487, 1918. *Milium cimicinum* Linn. Mant. Alt. 184, 1771.

On alkaline and eroded lands, Fatehkhera, N.B.G. 68851; Rehmankhera, N.B.G. 68840.

Aristida adscensionis Linn. Sp. Pl. 82, 1753. var. **adscensionis.**

On old walls and steep banks, common in Daulatgunj-Ranigunj area, N.B.G. 68807.

Aristida setacea Retz. Obs. Bot. 4 : 22, 1786.

On old walls, Daulatgunj-Ranigunj area, N.B.G. 68808, and on eroded lands, Rehmankhera, N.B.G. 68862.

Arthraxon lancifolius (Trin.) Hochst. in Flora 39 : 188, 1856. *Andropogon lancifolium* Trin. in Mem. Acad. Sci. Petersb., ser. 6, 2 : 271, 1832.

On old walls, National Botanic Gardens, N.B.G. 68815.

Arundo donax Linn. Sp. Pl. 81, 1753.

Along rainwater channels, Hussainabad area, N.B.G. 68809.

Bothriochloa odorata (Lisboa) A. Camus in Ann. Soc. Linn. Lyon, n.s., 76 : 165, 1931. *Andropogon odoratus* Lisboa in J. Bombay nat. Hist. Soc. 4 : 123, 1889.

In grasslands, Barabanki road, m. 7, N.B.G. 68801.

Brachiaria distachya (Linn.) Stapf in Prain, Fl. Trop. Afr. 9 : 565, 1919. *Panicum distachyum* Linn. Mant. Alt. 183, 1771.

Along ditches, Ismailgunj, N.B.G. 68802.

Brachiaria reptans (Linn.) Gard. et Hubbard in Hook. Icon. Pl. sub tab. 3363, 1938. *Panicum reptans* Linn. Syst. Nat., ed. 10, 870, 1759.

On old walls, Mahanagar, N.B.G. 68805.

Cenchrus biflorus Roxb. Fl. Ind. 1 : 238, 1820. *C. catharticus* Del. Cat Hort. Monsp. 1835, 4 : 1939.

Dry sandy fields, Bastauli Farm, N.B.G. 68819.

Cenchrus setigerus Vahl, Enum. Pl. 2 : 359, 1796. *C. biflorus* of Fl. Brit. India 7 : 89, 1896, non Roxb. 1820.

Eroded lands, Kukrail Reserve Forest, N.B.G. 68863, and Bastauli Farm, N.B.G. 68820.

Chloris dolichostachya Lagasca, Gen. et Spec. Pl. 5, 1816. *C. incompleta* Roth, Nov. Pl. Sp. 60, 1821.

In shade of shrubs, Goila forest, N.B.G. 68825, and Improvement Trust Forest, N.B.G. 68838.

Chloris montana Roxb. Fl. Ind. 1 : 331, 1820.

On alkaline and eroded lands, Fatehkhera, N.B.G. 68852, and Bakshi Talab-Asti road, N.B.G. 68864.

Chloris virgata Sw. Fl. Ind. Occ. 1 : 202, 1797.

On old walls, Daulatgunj-Ranigunj area, Hussainabad, and National Botanic Gardens, N.B.G. 68859.

Crypsis schoenoides (Linn.) Lamk. Tab. Encycl. 1 : 166, 1791. t. 42. *Phleum schoenoides* Linn. Sp. Pl. 60, 1753.

On damp soil along Gomti river, N.B.G. 68830.

Dichanthium caricosum (Linn.) A. Camus in Bull. Mus. Hist. Nat. Paris 27 : 549, 1921. *Andropogon caricosum* Linn. Sp. Pl. 1980, 1763.

Most grasslands and wastelands in the district, N.B.G. 68816.

Digitaria longiflora (Retz.) Pers. Syn. Pl. 1 : 85, 1805. *Paspalum longiflorum* Retz. Obs. Bot. 4 : 15, 1786.

Eroded lands along Loni nala, N.B.G. 68812.

Digitaria stricta Roth ex Roem. et Schult. Syst. Veg. 2 : 474, 1817. *D. royleana* (Nees) Prain, Bengal Pl. 1182, 1903.

Eroded lands along Loni nala, N.B.G. 68812, Rehmankhera, N.B.G. 68866.

Eragrostis cilianensis (All.) Vignolo-Lulalati in Malpighia 18 : 386, 1904. *Poa cilianensis* All. Fl. Pedem. 2 : 246, 1785, t. 91. *Eragrostis major* (Linn.) Host Gram. Austr. 4 : 14, 1809.

On old walls, Chinhat village, N.B.G. 68826.

Eragrostis ciliaris (Linn.) R.Br. in Tuchey, Narr. Exp. Congo. App. 478, 1818. *Poa ciliaris* Linn. Syst. Nat. 2 : 875, 1759.

Eragrostis diarrhena (Schult.) Steud. Syn. Pl. Glu. 1 : 266. 1854. *Poa diarrhena* Schult. Syst. Veg. 2, Mant. 616, 1827.

Along ditches. Kukrail area, N.B.G. 68847.

Eragrostis japonica (Thunb.) Trin. in Mem. Acad. Sci. Petersb., ser. 6, 1 : 405, 1831. *Poa japonica* Thunb. Fl. Jap. 51, 1786.

Along ditches and in moist lands, National Botanic Gardens, N.B.G., 68831.

Eragrostis nutans (Retz.) Nees ex Steud. Nom. Bot., ed. 2, 563, 1840. *Poa nutans* Retz. Obs. Bot. 4 : 19, 1786.

Common in moist wastelands, National Botanic Gardens woodland, N.B.G. 68817.

Eragrostis pilosa (Linn.) Beauv. Ess. Agrost. 71, 162, 175, 1802. *Poa pilosa* Linn. Sp. Pl. 68, 1753.

Common in moister grasslands, National Botanic Gardens, N.B.G. 68848.

Eragrostis tremula Hochst. ex Steud. Syn. Pl. Glum. 1 : 264, 1854.

Dry, sandy and eroded lands, Bastauli Farm, N.B.G. 68821, Ujarion, N.B.G. 68850.

Eremopogon foveolatus (Del.) Stapf in Prain, Fl. Trop. Afr. 9: 183, 1917. *Andropogon foveolatus* Del. Fl. Egypte 16, 1812, t. 8.

Eroded lands, Military area Arjungunj, N.B.G. 68843.

Erianthus ravennae (Linn.) Beauv. Ess. Agrost. 14, 1812. *Andropogon ravennae* Linn. Sp. Pl. 1481, 1763.

Along Gomti bank, N.B.G. 68832.

Eulalia leschenaultiana (Decne.) Ohwi in Bull. Tokyo Sci. Mus. 18 : 2, 1947. *E. cumingii* (Nees) A. Camus in Lecompte, Fl. Gen. Indoch. 7 : 250, 1922. *Pollinia cumingii* Nees in Hook. Kew J. Bot. 2 : 98, 1850.

In a depressed field south of Kukrail Forest road crossing, N.B.G. 68849.

Hackelochloa granularis (Linn. f.) O. Ktze. Rev. Gen. Pl. 776, 1891. *Manisuris granularis* Linn. f. Nov. Gram. 40, 1779.

Sand covered open fields, Bastauli Farm, N.B.G. 68822.

Heteropogon contortus (Linn.) Beauv. ex Roem. & Schult. Syst. Veg. 2 : 836, 1817. *Andropogon contortus* Linn. Sp. Pl. 1045, 1753.

Common in grasslands, Arjungunj Military Farm, N.B.G. 68844, along railway line and elsewhere.

Hygrorhiza aristata (Retz.) Nees apud Wt. & Arn. in Edinb. New Phil. J. 15 : 380, 1833. *Pharus aristatus* Retz. Obs. Bot. 5 : 23, 1789.

On sides of Kathauta tal near Malhaur railway station, N.B.G. 68803.

Ischaemum rugosum Salisb. Icon. Stirp. Rar. 1 : t. 1, 1791.

In paddy fields, Bakshi Talab-Asti road, N.B.G. 68806.

Leersia hexandra Swartz, Prod. Veg. Ind. Occ. 21, 1788.

In ditches near Tiwarigunj, N.B.G. 68829.

Mnesithea laevis (Retz.) Kunth, Rev. Gram. 1 : 154, 1829. *Rottboellia laevis* Retz. Obs. 3 : 11. 1783.

Common on sandy low banks of Gomti river at Bari, at Arjungunj, N.B.G. 8845, and National Botanic Gardens, N.B.G. 68833.

Oplismenus compositus (Linn.) P. Beauv. Ess. Agrost. 54, 168, 1812. *Panicum compositum* Linn. Sp. Pl. 57, 1753.

In shade of trees in Improvement Trust Forest, Moosa Bagh, N.B.G. 68839.

Panicum austro-asiaticum Ohwi in Act. Phyto-tax. et Geo-Bot. 2: 45, 1942. *P. humile* Nees ex Steud. Pl. Gen. 1 : 84, 1854 (non Thunb. ex Trin.).

Exposed situations, wastelands, eroded lands, etc., N.B.G. 68814.

Panicum paludosum Roxb. Fl. Ind. 1 : 310, 1820.

On sides of Kathauta tal near Malhaur railway station, N.B.G. 68804.

Panicum psilopodium Trin. Gram. Panic. 217, 1826, var. **psilopodium**.

Moist situations, Kukrail farms, N.B.G. 68827.

Panicum trypheron Schult., Syst. Veg. 2, Mant. 244, 1824.

Most wastelands, N.B.G. 68823, 68834.

Perotis indica (Linn.) O. Ktze. Rev. Gen. Pl. 787, 1891. *Anthoxanthum indicum* Linn. Sp. Pl. 28, 1753.

Sandy and exposed moist areas, Bastauli Farm, N.B.G. 68824, National Botanic Gardens, N.B.G. 68817, 68841.

Phragmites karka (Retz.) Trin. ex Steud. Nom. Bot., ed. 2, 2 : 324, 1841. *Arundo karka* Retz. Obs. Bot. 4 : 21, 1786.

In moist localities, N. B. G. 68856.

Poa annua Linn. Sp. Pl. 61, 1753.

In shady areas of the National Botanic Gardens, in winter, N.B.G. 68857, 68858.

Polypogon monspeliensis (Linn.) Desf. Fl. Atlant. 1 : 67: 1798. *Alopecuros monspeliensis* Linn. Sp. Pl. 61, 1753.

In lawns, along water channels, National Botanic Gardens, N.B.G. 68859, and Mahanagar, N.B.G. 68860.

Rottboellia exaltata Linn. f. Nov. Gram. Gen. 40, 1779, t. 1, et Suppl. Pl. 114, 1781.

Wastelands in National Botanic Gardens woodland, N.B.G. 68835.

Sporobolus coromandelinus (Retz.) Kunth, Rev. Gram. 1 : 68, 1829. *Agrostis coromandelinus* Retz. Obs. Bot. 4 : 19, 1786.

On old walls and kachcha roads, Chinhat village, N.B.G. 68828, and National Botanic Gardens, N.B.G. 68836.

Themeda triandra Forsk. Fl. Aeg.-Arab. cxiii et 178, 1775.

On grasslands, Barabanki road, m. 7, N.B.G. 68854, Arjungunj Military Farm. N.B.G. 68846.

Tragus biflorus Schult. Syst. Veg. 2, Mant. 205, 1824.

On eroded lands, Rehmankhera, N.B.G. 68842.

Vetiveria zizanioides (Linn.) Nash in Small, Fl. South-East. U.S.A. 67, 1903. *Phalaris zizanoides* Linn. Pl. 2 : 183. 1771.

In depressed lands which get filled up with water during the rains ; most parts of the district.

The author acknowledges with thanks the kind encouragement received during the course of this work from Prof. K. N. Kaul, F.L.S., Director, National Botanic Gardens, Lucknow.

NATIONAL BOTANIC GARDENS,
LUCKNOW,
May, 15, 1963.

J. G. SRIVASTAVA

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1962-63

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HONORARY SECRETARY'S REPORT FOR THE YEAR 1962, WITH SUPPLEMENTARY REMARKS FOR THE PERIOD JANUARY TO APRIL 1963

At the last Annual General Meeting of the Society we presented a report for the period ending 31st August 1962. The present report covers the 4 months thereafter.

THE SOCIETY'S JOURNAL

Two numbers of the *Journal* completing Vol. 59 were published during the period under report. The 651 pages include 5 papers each on insects and botany, 2 each on mammals and birds, and one each on national parks, reptiles, fish, and Annelids. 54 Miscellaneous Notes covered many subjects and, together with the papers, included descriptions of several new species and races of different forms of animals and plants. We are continuing our efforts to make the *Journal* of greater interest to the naturalist while maintaining the high standard of the past, and hope that members will help by sending in notes of their observations on various aspects of natural history. During the present national emergency the prospects of receiving grants from Government have been adversely affected and, therefore, it will not be possible to include as many illustrated articles as in previous years.

GENERAL

New Building. In late 1962 construction of the new building in the compound of the Prince of Wales Museum of Western India was begun. The foundation and part of the mezzanine floor have been completed and, if we receive all the funds that we are hoping to get from the Ministry of Scientific Research and Cultural Affairs, Government of India, we hope to have the building ready for occupation by the middle of 1964. The total cost of the building is estimated to be Rs. 3,30,343 ; a grant of Rs. 1,50,000 has already been received. We are grateful to the Government of India for the grant and to the Trustees of the Prince of Wales Museum of Western India for permission to house the Society on their land.

BNHS/WHO Bird Migration Study Scheme. We have had a very successful half-year in the Bird Migration Study Project. The two camps held at Bharatpur (September/October 1962) and Kerala (December 1962 to February 1963) resulted in the ringing of 2109 migrant birds at the former and 20,369 migrants at the latter. The species involved were Spanish Sparrows (*Passer hispaniolensis*) and several subspecies of the Yellow Wagtail (*Motacilla flava*). At the invitation of the WHO Prof. G. I. Netzky, Parasitologist of the Institute for Diseases with Natural Foci, Omsk, U.S.S.R., spent two weeks at our Bharatpur camp in order to familiarise himself with our techniques to help him devise an adequate scheme for co-operation between the Society and Russian workers on the virological aspects.

Research Grant from C.S.I.R. During the year a project for studying 'The Role of Birds in our National Economy', financed by the Council of Scientific and Industrial Research, was commenced. One student investigator has been appointed and the University Department of the Society has another vacancy under the scheme for a competent graduate student of botany. Applications from possible candidates are invited.

Research Grant from University of Bombay. The University of Bombay sanctioned a research grant to Mr. V. C. Ambedkar for continuing his field work on the breeding biology of weaver birds on which subject he was awarded his M. Sc. degree.

Talks. Members in Bombay had the opportunity of hearing Major John Dias on the 1962 Indian Everest Expedition.

New Additions to our Collection. During the year some 104 additions were made to our registered collections of vertebrates: 33 birds, 47 reptiles, and 24 amphibians. Interesting additions among reptiles and amphibians include : *Japalura kumaonensis*, *Trimeresurus huttoni*, and *Uperodon systoma*.

Library. During the year 59 books were added to the library of which 33 were purchased, 14 received for review, and 12 donated. Our thanks are due to the donors. 59 journals were bound.

PUBLICATIONS

We expect to publish the revised second edition of THE BOOK OF INDIAN ANIMALS (now in the press) early next year. The sale of our other publications, except THE BOOK OF INDIAN BIRDS, has not been satisfactory and continues to be a matter of concern to the Committee.

NATURE EDUCATION SCHEME

The Nature Education Scheme for children financed by the Government of Maharashtra is now in its 15th year. Tours of the Natural History Section of the Prince of Wales Museum and special talks on natural history subjects with the aid of exhibits and other specimens, films, and living animals were continued.

One field trip for teachers was arranged. It was led by Dr. R. N. Sukheshwala of the Geology Department of St. Xavier's College, Bombay.

MEMBERSHIP

The total membership on our books at the end of 1962 was 1215, including 240 life and 4 honorary members. Subscriptions were received from 763 members, and we hope to receive subscriptions from most of the remaining 208 members, except for the few who cannot be traced. During 1962, 112 ordinary members and 7 life members were enrolled as against 61 ordinary members resigned, and 4 life members who died during the year.

REVENUE ACCOUNT FOR 1962

During the year 1962 the income of the Society, excluding the special grant received from the Government of Maharashtra for the maintenance of the Reference Collections, was Rs. 54,223.96 as against Rs. 42,701.84 in the previous year. The operations of the Society during 1962 showed a deficit of Rs. 5,632.94 as against Rs. 19,955.45 in 1961.

STAFF

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

ACKNOWLEDGEMENTS

The Committee's thanks are due to Mr. J. L. Bernard who continues to look after the Society's interests in the United Kingdom.

SUPPLEMENTARY REMARKS FOR THE PERIOD JANUARY TO APRIL 1963

GENERAL

Honorary Secretary. In January 1963 the Committee accepted with great regret the resignation of Mr. Humayun Abdulali as Honorary Secretary of the Society. Mr. Abdulali during the last 14 years, has done a great deal to further the objects of the Society. It is largely due to his persistent efforts that the construction of the new building to house the Society has become possible, and his work has been deeply appreciated. Mr. Abdulali, after his resignation, continues to be the Society's representative on the Indian Board for Wild Life, the State Wild Life Advisory Board, and the Board of Trustees of the Prince of Wales Museum of Western India.

Research Work. The Society is sponsoring a study of the ecology of the Indian Red and Grey Junglefowls by Dr. N. E. Collias, Associate Professor of Zoology, University of California, Los Angeles 24, U.S.A., who has already commenced his work.

Society's Nominee on H.M.I. Training Courses. The Himalayan Mountaineering Institute have agreed to have a nominee of the Society included in their mountaineering courses every year. This proposal was made to them with the object of spreading interest in ornithology among mountaineers. K. S. Lavkumar of Jasdan was nominated by us for the course in April this year, but unfortunately he was not able to participate. It is hoped that candidates will be available in future to take advantage of this offer by the Himalayan Mountaineering Institute.

Talks and Film Show. Rev. Fr. H. Santapau, S.J., gave a lecture on 14th February to members in Bombay on the impressions of a botanist on a tour of Russia, and the Films Division, Government of India, kindly arranged a special show on 25th March at their Auditorium of the films 'Gir Sanctuary', 'A Trek to Pindari Glacier', and 'Beauty in Bloom' for members of the Society.

NATURE EDUCATION SCHEME

The activities of the scheme were extended to Poona, and the Nature Education Organiser visited Poona twice during the period under review and conducted nature rambles and contacted several schools to discuss the possibility of permanently organising nature education activities at Poona. He also visited the National Defence Academy at Khadakvasla and the Cadets seem to be keenly interested in having further talks and rambles arranged for them.

Registered No. F **244 (BOM)**

THE BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE VII [VIDE RULE 17 (1)]

BALANCE SHEET AS AT 31 DECEMBER 1962

FUNDS AND LIABILITIES		Rs. nP.	Rs. nP.
Trust Fund or Corpus:			
Life Membership Fund			
Balance as per last Balance Sheet ..		71,165.28	
Add: Amount received during the year		3,280.00	74,445.28
Fixed Assets Fund:			
Balance as per last Balance Sheet	71,222.61		
Less: Depreciation adjusted	10,458.73		60,763.88
Other Earmarked Funds:			
Field Work Fund ..			
Balance as per last Balance Sheet	1,501.33		
Less: Spent during the year	11.54	1,489.79	
Wild Life Fund			
Balance as per last Balance Sheet	475.24		
Less: Spent during the year	257.85	217.39	
Mammal Survey Fund			
Balance as per last Balance Sheet	2,128.16		
Less: Spent during the year.	1,039.05	1,089.11	
Carried forward ..		2,796.29	1,35,209.16

ASSETS	Rs. nP.	Rs. nP.
Immovable Properties:		
Motor Car		
Balance as per last Balance Sheet ..	19,362.46	
Less: Depreciation during the year ..	3,872.46	15,490.00
Furniture, Fixtures, & Equipment:		
Balance as per last Balance Sheet ..	52,693.27	
Less: Depreciation during the year ..	6,586.27	46,107.00
Copyright Account		5,184.34
Investments:		
Rs. 14,000 4% Bombay Port Trust Bonds ..	10,780.00	
Rs. 15,000 4% Bombay Improvement Trust Bonds ..	11,400.00	
Rs. 36,000 3% Funding Loan 1966/68	35,812.62	
Rs. 25,000 3% Conversion Loan 1946 ..	25,000.00	
Rs. 2,000 3% 1st Development Loan 1970/75 ..	1,948.75	
Rs. 92,000 (Market Value Rs. 79,539.00) ..	84,941.37	
£ 460 3½% Defence Bonds ..	6,133.34	
	91,074.71	
Less: Provision for Depreciation ..	3,750.00	87,324.71
Carried forward ..		1,54,106.05

BALANCE SHEET AS AT 31 DECEMBER 1962—(*continued*)

FUNDS AND LIABILITIES		Rs. nP.	Rs. nP.
Brought forward ..			1,35,209.16
Other Earmarked Funds B/F ..		2,796.29	
Expedition Fund			
Balance as per last Balance Sheet		1,800.00	
Building Fund			
Balance as per last Balance Sheet	29,150.00		
Add: Amount received from Prince of Wales Museum	850.00		
		30,000.00	
Publication Fund			
Balance as per last Balance Sheet		30,725.00	
Nature Education Trophy Fund			
Balance as per last Balance Sheet	250.00		
Less: Spent during the year	250.00		
		nil	
Unspent Grant, Govt. of Maharashtra			
1960-61 Unspent Balance brought forward ..		842.47	
1961-62 Unspent Balance brought forward ..	9,328.32		
Less: Spent during the year (As per Income and Expenditure Account) ..	8,979.57		
		348.75	
Carried forward ..		66,512.51	1,35,209.16

ASSETS			Rs. nP.	Rs. nP.
Brought forward ..				1,54,106.05
Loans: (Unsecured)	*Good*	*Doubtful*		
Loan Scholarship	nil	nil		
Other Loans (to staff)	260.00	nil		
				260.00
Advances:				
To Trustees ..		—		
,, Employees (WHO Kerala Trip) ..		2,000.00		
,, Employees (WHO Local Trip) ..		100.00		
,, Employees (WHO Purchases) ..		160.00		
			2,260.00	
,, Contractors			—	
,, Lawyers ..			—	
,, Nature Education Scheme ..			2,827.47	
,, Others			6.20	
,, Prepaid Expenses			60.00	
				5,153.67
Stocks: (At cost or under)				
Books and Publications ..			41,484.85	
Blocks etc.			6,060.96	
(As certified by the Hon. Secretary)				47,545.81
Income Outstanding:				
Rent			—	
Interest (Accrued)			1,416.56	
Other Income:				
Supplies and Services ..			15,500.56	
Government of Maharashtra Education Activity Grant 1962-63			4,000.00	
Carried forward ..			20,917.12	2,07,065.53

BALANCE SHEET AS AT 31 DECEMBER 1962—(*continued*)

FUNDS AND LIABILITIES		Rs. nP.	Rs. nP.	ASSETS	Rs. nP.	Rs. nP.
Brought forward ..			1,35,209.16	Brought forward ..		2,07,065.53
Other Earmarked Funds: B/F		66,512.51		*Income Outstanding* (contd.)	20,917.12	
Unspent Grant Government of Maharashtra				*Other Income:*		
1962-63 Grant for the year	37,000.00			Government of Maharashtra Maintenance Grant 1962-63	37,000.00	
Less: Spent during the year (as per Income & Expenditure Account) ..	27,794.70					57,917.12
		9,205.30		*Cash and Bank Balances:*		
Unspent Grant World Health Organization				(*a*) In Current Account with National and Grindlays Bank Ltd., Bombay	1,923.84	
Balance as per last Balance Sheet	35,567.40			In Current Account with National and Grindlays Bank Ltd., London (£ 237-11-2) ..	3,167.42	
Add: Amount received during the year ..	23,810.00			In Current Account with Chartered Bank, Bombay ..	1,326.47	
	59,377.40			In Fixed Deposit with:		
Less: Utilised during the year	23,012.08			National & Grindlays Bank Ltd., Bombay ..	15,000.00	
		36,365.32		Chartered Bank, Bombay ..	25,000.00	
				(All the above Accounts are in the name of the Bombay Natural History Society)		
				(*b*) With the Trustee	—	
				(*c*) With the Cashier	650.00	
						47,067.73
Carried forward ..		1,12,083.13	1,35,209.16	Carried forward ..		3,12,050.38

BALANCE SHEET AS AT 31 *DECEMBER* 1962—(*continued*)

FUNDS AND LIABILITIES	Rs. nP.	Rs. nP.	ASSETS	Rs. nP.	Rs. nP.
Brought forward ..		1,35,209.16	Brought forward ..		3,12,050.38
Other Earmarked Funds : B/F	1,12,083.13				
Loans:			*Income and Expenditure Account:*		
Loan (unsecured) from Prince of Wales Museum (for publication of Animal Book, 2nd edition) ..	25,000.00		Deficit as per Income and Expenditure Account	5,631.94	
Liabilities:			*Less*: Balance of Surplus as per last Balance Sheet	1,662.95	
For Expenses .. 41,977.16					3,968.99
,, Advance Subscription.. 901.90					
,, Sundry Credit Balances 848.02	43,727.08				
		1,80,810.21			
Total ..		3,16,019.37	Total ..		3,16,019.37

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Properties and Assets of the Trust.

As per our report of even date

(Sd.) A. F. Ferguson & Co.,
Chartered Accountants

(Sd.) J. D. Kapadia,
Trustee

Bombay, *2nd May*, 1963

Registered No. F **244 (BOM)**

THE BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE IX [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER* 1962

EXPENDITURE	Rs. nP.	Rs. nP.	INCOME	Rs. nP.	Rs. nP.
To Expenses in respect of properties :			*By Rent :*		
Rates, Taxes, Cesses, Repairs, and Maintenance	nil		Accrued	nil	
Salaries	nil		Realised	nil	nil
Insurance	nil		,, *Interest* (Accrued and Realised) :		
Depreciation (by way of provision or adjustments)	nil	nil	On Securities	3,248.66	
,, *Expenditure from Grants Government of Maharashtra :*			On Bank Account	1,085.52	
For 1961-62 : Salaries	3,729.57				4,334.18
Rent	5,250.00		,, *Dividends*		nil
		8,979.57	,, *Donations :*		
For 1962-63 : Salaries	11,948.10		In cash	nil	
Rent	15,846.60		In kind	nil	nil
		27,794.70	,, *Grants :*		
,, *Establishment Expenses :*			*Government of Maharashtra*		
Salaries (Including Dearness Allowance)	32,981.92		For 1961-62 (Expended as per contra)	8,979.57	
Society's contribution to Staff Provident Fund	1,643.58		For 1962-63 (Expended as per contra)	27,794.70	
Postages	1,329.72		For Educational Activity 1962-63	4,000.00	
Printing and Stationery	1,469.64		*Government of India :*		
Advertisement	44.00		For Journal Expenses for 1962-63	10,000.00	
					50,774.27
Carried forward	37,468.86	36,774.27	Carried forward		55,108.45

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER* 1962—(*continued*)

EXPENDITURE	Rs. nP.	Rs. nP.
Brought forward		36,774.27
To Establishment Expenses—B/F	37,468.86	
Telephone charges	735.63	
Bank charges	190.46	
Electric charges	346.98	
Meeting Expenses	273.91	
Motor Car charges Account	225.00	
Conveyance and Travelling expenses	682.42	39,923.26
,, Remuneration to Trustees	nil	
,, Remuneration (In the case of Math)	nil	
,, Legal Expenses	nil	
,. Audit Fees	750.00	750.00
,, *Amounts Written off :*		
Bad Debts	nil	
Loan Scholarships	nil	
Irrecoverable Rents	nil	
Other Items	nil	nil
,, *Miscellaneous Expenses :*		
General Charges	1,448.61	
Fire Insurance	110.30	
Interest on Overdraft Account	52.06	
Donation to Zoological Society London	66.67	
Sales Tax	1,667.11	3,344.75
Carried forward Rs.		80,792.28

INCOME	Rs. nP.	Rs. nP.
Brought forward		55,108.45
By Income from Other Sources :		
Subscriptions	21,997.69	
Entrance Fees	585.00	22,582.69
,, *Publications :*		
Journal Sales	4,046.37	
,, *Books etc. profits :*		
Book of Indian Birds	10,074.64	
Some Beautiful Indian Climbers and Shrubs	965.00	
Some Beautiful Indian Trees	518.07	
Butterflies of the Indian Region	1,754.16	
Synopsis of Birds of India and Pakistan	1,278.73	
Game Birds of India, Burma, and Ceylon Vol. III	227.93	
Indian Molluscs	142.52	
Carried forward Rs.	19,007.42	77,691.14

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1962—(*continued*)

EXPENDITURE	Rs. nP.	Rs. nP.	INCOME	Rs. nP.	Rs. nP.
Brought forward ..		80,792.28	Brought forward ..		77,691.14
To *Depreciation :*			*By Books etc. profits*—B/F ..	19,007.42	
On Investments	nil		Identification of Poisonous Snake Charts	791.25	
On Furniture	nil	nil			
,, *Expenditure on objects of the Trust :*			Calendars	853.76	
(*a*) Religious	nil				
(*b*) Educational—Journal Expenses ..	23,758.42		Other Publications	199.76	
—Library Account (Subscriptions to other Societies) ..	570.42			20,852.89	
—Purchase of Books	426.85		*Less* : Packing and Forwarding charges	620.10	
—Periodical and Binding charges ..	134.00				20,232.09
			,, Miscellaneous Receipts ..		3,075.00
—Maintenance of Reference Collections ..	948.20	25,837.89	,, Deficit carried to Balance Sheet ..		5,631.94
Total ..		1,06,630.17	Total ..		1,06,630.17

As per our report of even date

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants

BOMBAY, 2nd *May*, 1963.

(Sd.) J. D. KAPADIA,
Trustee

THE BOMBAY NATURAL HISTORY SOCIETY

STATEMENT OF INCOME AND EXPENDITURE WITH RESPECT TO THE PUBLICATION OF JOURNAL FOR THE YEAR ENDED 31ST DECEMBER 1962

EXPENDITURE	Rs. nP.	INCOME	Rs. nP.
To Establishment Expenses :		*By Publications :*	
1/3 of Salaries including Dearness Allowance,		Journal Sales	4,046.37
Society's contribution to Staff Provident Fund		1/3 of Membership Subscriptions	7,332.56
Postage		,, *Grants :*	
Printing and Stationery		Government of India for publication of Journal 1962-63	10,000.00
Advertisement			
Telephone Call charges			
Bank charges			
Conveyance Expenses			
Electric Charges			
Meeting Expenses			
Motor Car charges Account	13,307.75		
1/3 of Audit Fees	250.00		
,, *Miscellaneous Expenses :*			
1/3 of General charges, Fire Insurance, Sales Tax, etc.	1,114.91		
,, *Expenditure on object of the Trust :*			
Journal Expenses	23,758.42		
1/3 of Library Expenses, Purchase of Books and periodicals and Binding charges	377.09		
1/3 of Maintenance of reference collections	316.06		
Total	39,124.23	Total	21,378.93

As per our report of even date

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants

(Sd.) J. D. KAPADIA,
Trustee

BOMBAY, *2nd May* 1963

THE BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the year ended 31st December 1962

RECEIPTS		Rs. nP.	Rs. nP.
To Balance as at 1st January 1962			
Brought forward			
Cash with Cashier		50.00	
Balance with Bank on Current Account		83.62	133.62
,, Grant Government of Maharashtra 1961-62			6,640.00
,, Sales of Booklet No. I	443.00		
,, Sales of Booklet No. II	190.93		
,, Sales of Booklet No. III	287.39		
,, Sales of Booklet No. IV	381.35		
,, Sales of Booklet No. V	370.33		1,673.00
,, Sales of Nature Study Pamphlets and Line drawings			27.22
,, Balance carried forward being advance from Bombay Natural History Society			2,827.47
Total ..			11,301.31

PAYMENTS		Rs. nP.
By Balance brought forward, being advance from Bombay Natural History Society		3,499.53
,, Salaries of Nature Education Organiser ..		5,640.00
,, Postages		142.40
,, Printing and Stationery		127.71
,, Cost of Booklet No. V (in part payment) ..		1,500.00
,, General charges		240.06
,, Balance as at 31st December 1962 :		
Cash with the Cashier	50.00	
With Bank on Current Account ..	100.81	150.81
Total ..		11,301.31

BOMBAY, 2*nd May*, 1963

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE PREMISES OF THE SOCIETY, 91 WALKESHWAR ROAD, BOMBAY 6, ON FRIDAY 31ST MAY 1963 AT 6 P.M., WITH DR. SÁLIM ALI IN THE CHAIR

1. The Honorary Secretary's report for the year 1962, with supplementary remarks for the period January to April 1963, having been previously circulated to members was taken as read and adopted.

2. The Balance Sheet and Statement of Accounts for 1962 presented by the Honorary Treasurer were approved.

3. The following were elected as members of the Executive and Advisory Committee for the year 1963-64.

EXECUTIVE COMMITTEE

ex-officio

President

MRS. VIJAYA LAKSHMI PANDIT, *Governor, State of Maharashtra*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S. (Retd.)
Rev. Fr. H. Santapau, S.J.
Dr. Sálim Ali

Hon. Secretary

Mr. Zafar Futehally

Hon. Treasurer

Mr. J. D. Kapadia, I.C.S. (Retd.)

Members

Mr. Humayun Abdulali
Dr. D. V. Bal, M.SC., Ph.D.
Mr. G. V. Bedekar, I.C.S.
R. S. Dharmakumarsinhji
Mr. R. E. Hawkins
Dr. C. V. Kulkarni, M.SC., Ph.D.
Mr. D. J. Panday
Mr. G. S. Ranganathan
Dr. T. Ramachandra Rao, D.SC., F.N.I.
Mr. D. E. Reuben, I.C.S. (Retd.)

Advisory Committee

Mr. H. G. Acharya, F.R.E.S.	*Ahmedabad*
Mr. F. C. Badhwar, O.B.E.	*New Delhi*
Sir C. D. Deshmukh, Kt., C.I.E., I.C.S. (Retd.)	*New Delhi*
Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D.	*Mysore*
Mr. E. P. Gee, M.A., C.M.Z.S.	*Shillong*
Dr. Baini Prasad, D.Sc., F.N.I.	*Dehra Dun*
Mr. P. D. Stracey, I.F.S. (Retd.)	*Shillong*
Dr. M. L. Roonwal, M.Sc., Ph.D., & Sc.D. (Cantab.), F.N.I., F.Z.S.I.	*Calcutta*
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.E.E.	*Roorkee*
Y. S. Shivrajkumar of Jasdan	*Jasdan*

4. Two films 'Sea Sanctuary' and 'Winter Quarters' loaned by the British Information Services were exhibited and greatly appreciated.

5. The meeting terminated with a vote of thanks to the British Information Services for the loan of the films, and to the Chairman of the meeting.

Notes and News

We are glad to announce a new Society publication:

THE LYCAENIDAE PORTION (EXCEPT THE ARHOPALA GROUP) OF BRIGADIER EVANS' THE IDENTIFICATION OF INDIAN BUTTERFLIES 1932 (INDIA, PAKISTAN, CEYLON, BURMA). Reissued and Revised by Sir Keith Cantlie, C.I.E., Indian Civil Service (retired). Mimeographed. Price Rs. 10.

The revision of Brigadier Evans's classic work was found necessary as much work has been done on Lycaenidae since 1932 and there have been considerable changes in nomenclature. The Society is grateful to Sir Keith Cantlie who took on himself the entire responsibility for the preparation of the book and who has borne the greater portion of the cost. As very few copies of the book are available, members who are interested should reserve their copies at an early date.

Appeal for Bird Notes

Work has started on the long-projected HANDBOOK OF INDIAN BIRDS under the joint authorship of the undersigned and Prof. Dillon Ripley. The manual is planned to be completed in five volumes at intervals of about a year each. It will attempt to bring the Bird volumes of the FAUNA OF BRITISH INDIA series (2nd ed.) up-to-date for the taxonomist and museum worker, and also to provide the field naturalist with a fully illustrated guide to the complete avifauna of the Indian subcontinent. By bringing together all that is known about Indian birds in life it will serve to emphasize how little in fact we do know, and thus enable field workers to try and fill the gaps. The first volume is expected to be ready for the press in about fifteen months from now. It will cover the first 450-500 species and subspecies of Ripley's A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN etc. The undersigned will be grateful for field notes by bird watchers under any of the following heads: Distribution (additional to what is already published in the FAUNA and other standard works); Habitat (biotopes);

Food and Feeding Habits; Voice and Calls; Migration; Breeding (including courtship, period of incubation, share of the sexes in incubation and nest-feeding), Economics (if the bird or any of its parts or products are, or formerly were, used for particular purposes); Conservation. Any other observations relating to ecology or behaviour will be welcome. Though the immediate request is for notes pertaining to the birds to be covered by Vol. I, those for the subsequent volumes will also be appreciated.

33, Pali Hill,
Bandra, Bombay-50.

SÁLIM ALI

PRINTED AND PUBLISHED BY V. M. PHILIP AT THE DIOCESAN PRESS
10 CHURCH ROAD, VEPERY, MADRAS—12-11-1963. C9938
EDITORS: H. SANTAPAU & ZAFAR FUTEHALLY

THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater. With many coloured and monochrome plates. 2nd (revised) edition. (*In preparation*)

Birds

Game Birds of India, by E. C. Stuart Baker. Vol. III. Pheasants, 1st Edition. **Rs. 20**
(*Price to Members Rs.* 15)

The Book of Indian Birds, by Sálim Ali. With 64 coloured and many monochrome plates, 6th edition, revised and enlarged. **Rs. 25**
(*Price to Members Rs.* 20)

A Synopsis of the Birds of India and Pakistan, by S. Dillon Ripley II. An up-to-date checklist of all the birds resident and migrant, including those of Nepal, Sikkim, Bhutan, and Ceylon. **Rs. 25**
(*Price to Members Rs.* 20)

Snakes

Identification of Poisonous Snakes. Wall chart in English, Gujarati, and Marathi. **Rs. 10**
(*Price to Members Rs.* 8)

Miscellaneous

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 2nd edition. Revised by W. T. Stearn **Rs. 20**
(*Price to Members Rs.* 16)

Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. **Rs. 22**
(*Price to Members Rs.* 17.50)

Butterflies of the Indian Region, by M. A. Wynter-Blyth. With 27 coloured and 45 monochrome plates. **Rs. 28**
(*Price to Members Rs.* 22.50)

Indian Molluscs, by James Hornell. With 2 coloured and many monochrome plates, and text-figures. **Rs. 6**
(*Price to Members Rs.* 4.50)

Glimpses of Nature Series Booklets :

1. OUR BIRDS I (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. **Rs. 0.80**
   Kannada **Rs. 0.62**
2. OUR BIRDS II (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. **Rs. 0.62**
3. OUR BEAUTIFUL TREES (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. **Rs. 0.62**
4. OUR MONSOON PLANTS (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. **Rs. 0.80**
5. OUR ANIMALS (with 8 coloured plates) in English, Gujarati, Hindi, Marathi. **Rs. 1.25**

Back numbers of the Society's Journal. Rates on application.

Correspond with :
The Honorary Secretary,
Bombay Natural History Society,
91, Walkeshwar Road, Bombay 6-WB.

Agents in England :
Messrs. Wheldon & Wesley Ltd.,
Lytton Lodge, Codicote, Nr. Hitchin,
Herts., England.

The Society will gratefully accept back numbers of the *Journal,* particularly numbers prior to Vol. 45, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Life Members pay an entrance fee of Rs. 5 and a life membership fee of Rs. 500.

Ordinary Members pay an entrance fee of Rs. 5 and an annual subscription of Rs. 30.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

MEMBERS RESIDING OUTSIDE INDIA

The terms are the same for members living outside India. Such members should pay their subscriptions by means of orders on their Bankers to pay the amount of the subscription, plus postal registration (Rs. 2.50) if required—in all Rs. 32.50—to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £2-10-0 should be paid annually to the Society's London Bankers—The National & Grindlays Bank Ltd., 26 Bishopsgate Street, London, E.C. 2.

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Journal of the Bombay Natural History Society

506.54
B72

Vol. 60, No. 3

Editors
H. SANTAPAU, S.J., & ZAFAR FUTEHALLY

DECEMBER 1963

Rs. 15

NOTICE TO CONTRIBUTORS

Contributors of scientific articles are requested to assist the editors by observing the following instructions :

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names to be printed in italics should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and subspecific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 8.20 × 5.60 cm. (No. 2 Brownie) and on glossy glazed paper.

6. Text-figures, line drawings, and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus :

Banerji, M. L. (1958) : Botanical Exploration in East Nepal. *J. Bombay nat. Hist. Soc.* **55** (2) : 243-268.

Prater, S. H. (1948) : The Book of Indian Animals. Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus : (Banerji, 1958).

9. *Synopsis :* Each scientific paper should be accompanied by a concise, clearly written synopsis, normally not exceeding 200 words.

10. *Reprints :* Authors are supplied 25 reprints of their articles free of charge. In the case of joint authorship, 50 copies will be given gratis to be distributed among the two or more authors. Orders for additional reprints should be in multiples of 25 and should be received within two weeks after the author is informed of the acceptance of the manuscript. They will be charged for at cost plus postage and packing.

EDITORS,
Journal of the Bombay Natural History Society.

91, Walkeshwar Road,
Bombay 6-WB.

CORRECTION

Vol. 60, No. 3, in the credit captions to the plates illustrating the paper 'A Naturalist in Borneo', by Dr. T. Norman, correct '*Photos : T. Norman*' to '*Photos : W. P. Reid*'.

VOLUME 60, NO. 3—DECEMBER 1963

Date of Publication : 14 April 1964

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A Naturalist in Borneo

BY

DR. T. NORMAN[1]

(*With two plates*)

My wife and I recently had the good fortune to spend 9 months in North Borneo on our way back to England after 14 years in Assam. We were stationed at Wallace Bay on Sibatik Island, 2 hours by launch from Tawau, at the extreme SE. of the Colony and only 3 miles from the Indonesian border. Wallace Bay consists only of the headquarters of the Borneo branch of the Bombay Burmah Trading Corporation, but the isolation of the station was redeemed for us by the fact that good forest began only 200 yards behind our bungalow, and the sea, sometimes with as many as 5 timber ships at anchor at a time, 100 yards in front of us. We spent 2 consecutive days a fortnight at the Corporation's main timber camp, 3 hours from Wallace Bay by launch up the Kalabakan River, and 2 days a fortnight at Tawau to visit another timber camp and a cocoa estate, 17 and 25 miles respectively from Tawau on the road which will eventually lead to Mostyn. Living and working in such close proximity to the forest we were able to spend the midday hours there whenever the weather permitted. My wife's primary interest is ornithology, and my own butterflies, but we are sufficiently general Natural Historians for our interests to overlap and for us to take an intelligent interest in other branches.

Our biggest and continuing surprise in the Tawau area of Borneo was the climate. Rainfall is approximately the same as in central

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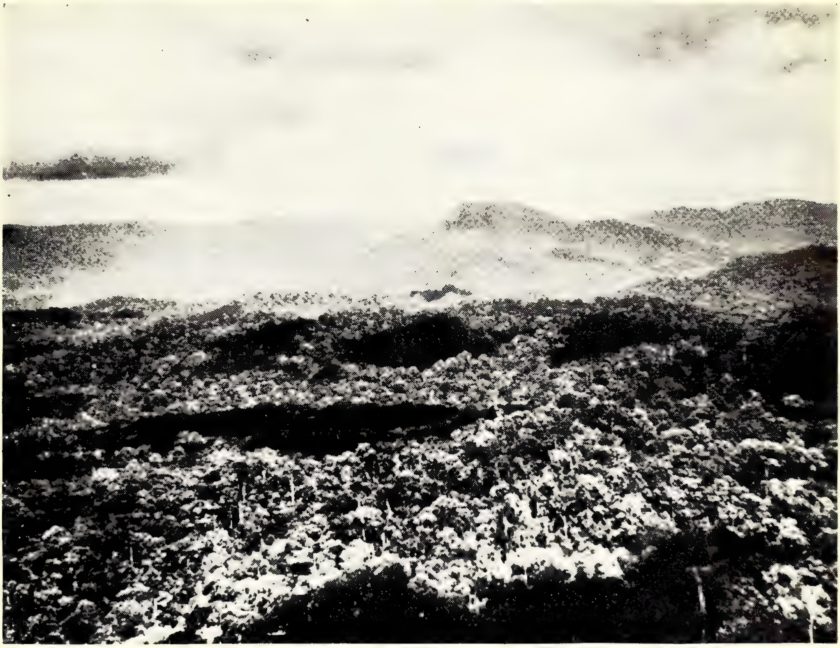
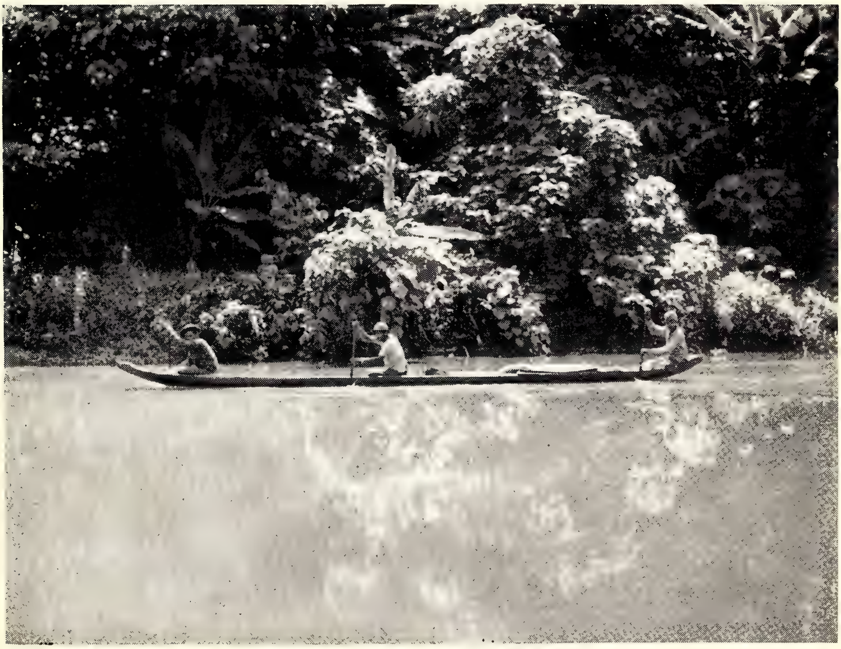
Assam, i.e. 80 in. a year, but is far more equally distributed. Without going into meteorological details, subjectively the climate is mild and pleasant, no single day of our 9 months being as unpleasantly hot and humid as the coolest monsoon day in the Assam Valley. There were other surprises, both of things present and things absent. *Agathis* sp. (the Kauri of New Zealand and Australia) and Podocarps, both typically Southern Hemisphere conifers, grew in the interior, and several *Rhododendron* spp. in the equatorial lowland rains forest. Unfortunately we saw none of these, nor will it be a surprise to a zoologist to learn that we failed to see the tapir, cassowary, and great black cockatoo illustrated on the stamps of the Chartered Company, pre-war rulers of what is now the Colony of North Borneo. After enquiring about these 3 vertebrates and vehemently denying the possibility of lowland rhododendrons I quickly learnt to keep to myself opinions based on Indian experience.

The figures usually given for the forest area of Borneo are 75% of the land under primary forest with another 15% under secondary forest, and a flight across the island certainly seems to bear these figures out. One can fly for half an hour and see nothing but virgin forest in every direction—although it must be explained that half an hour in a jet plane, or even in the familiar Dakota, is not the same thing as half an hour in a Borneo Airways' Pioneer, which looks as though it ought to be propelled by the piece of twisted rubber familiar in the toy planes of my boyhood. It is not easy to compare the primary forest of the lowlands of Borneo with similar forest areas in Assam, since so many of Assam's virgin forests are not, in fact, true primary forest. In the non-swampy areas the canopy appears to be at least 50 feet higher and more dense than in the best Assam forests, the boles straighter and proportionately more slender, and the forest floor more open. This picture gave place to the familiar Assam pattern of dense undergrowth, with much thorny rattan, wherever light had been let in. In open places, especially along roadsides, *Eupatorium* is firmly in control, coming into flower at about Christmas time but lasting into March. Although Tawau is in the tropics (4° N.), with no real seasons, the familiar plants of the Asian sub-tropics flower in their proper months but with a much longer flowering season. This long flowering season applies also to native plants. It was particularly noticeable with some of the more showy creepers, *Bauhinia kochi,* for instance. This very characteristic and lovely plant of Malaysia is not seen in India. It is a heavy creeper draping trees and stumps at the forest edge or wherever it can reach the sun; the flowers are small for a *Bauhinia,* of a rather variable but always very bright



Primary Forest in central North Borneo



Typical Secondary Forest on banks of Kalabakan River

Photos : T. Norman

Jesselton Airport with Borneo Airways' *Pioneer* in foreground

Iban fellers at foot of Red Serayah (*Shorea* sp.) tree

Photos : T. Norman

orange-red, in terminal corymbs which give the appearance of being flat-topped. It is quite as dramatically showy as the 'Golden Shower' (sometime *Bignonia venusta*) of Indian gardens.

A characteristic small tree of cleared areas was a species of *Wormia*, perhaps *burbidgii*, with very large leaves and large yellow flowers similar (except in size) to those of *Ochna* spp. This was a case where familiarity bred, if not contempt, at least disappointment, so that I no longer regretted my failure to make it thrive in Assam. After the excitement of finding a whole riverbank covered with *Nepenthes khasiana* during our last Christmas in Assam we had looked forward to seeing the many species of pitcher plants which grow further east, but they were very scarce in our area and we only found one small group (on Sibatik Island), although we saw many species on brief visits to Brunei and Sarawak. Orchids were a little disappointing. While it is true that many fine species occur in Borneo (for instance *Phalaenopsis* spp.), by far the most remarkable we saw in the wild was *Grammatophyllum speciosum*. This commonly grew perhaps 50 or 60 feet from the ground at the point where the first branches of a forest giant forked from the trunk, dwarfing the enormous size of the orchid itself. This may have 20 or 30 six-foot sprays of large tawny-orange flowers, the whole plant being large enough to fill completely an ordinary-sized room.

As elsewhere in the tropics, the lowland forests are melting away and giving place to cash crops—rubber, manilla hemp, cocoa, coconuts, and oil palm are important ones on the east coast—but the greatest clearing of forest is from the thriving timber industry. The Forest Department is active and progressive, although there is widely expressed concern (in which I agree) about the correctness of its method of forest perpetuation. Large areas have been set aside permanently for timber. After the concessionaires have felled what they require, the Forest Department moves in and poisons off all remaining trees right down to the smallest sapling size. It would be more correct to say that this is what has happened in areas I have personally been able to observe, but I believe the intention is to poison all the 'useless' species and leave only the smallest saplings and a few seed parents of the commercially desirable species, mainly Dipterocarps. The theory is that the 'useless' species will die out while pure stands of Dipterocarps will grow up tall and straight under the protection of the quickly growing secondary species. The method has been used extensively and, I believe, successfully in Malaya. No conservationist can approve of an attempt at such a radical alteration of the forest, but far worse than this, there is grave doubt as to whether it is even going to achieve its purpose in Borneo. As far as I can see from personal observation of large areas on the east coast, the Dipterocarps are germinating and starting to grow satisfactorily, but the growth of secondary species is so dense and dark that this has strangled the forest species, resulting in pure stands of dense (and useless) secondary growth after 5 years. In sharp contrast to this is the magnificent natural regeneration which has taken place around the Selimpopon River, where selective felling of commercial species took place in the earlier part of the century.

The relatively few species of common large animals occurred in great plenty—pig, particularly, in primeval numbers. Mouse-deer, barking deer, and sambar were common, and tembadau (local equivalent of the Indian gaur or bison) was said still to be plentiful a few days' march from Tawau. Elephants have never been as plentiful as on the Asian mainland, probably due to the less suitable food with relative scarcity of bamboo; in our area there was only known to be one, whose tracks we frequently found. Squirrels, lizards, and monkeys occurred in endless variety and vast numbers: flying squirrels and flying lizards, large monitor lizards and giant Malayan squirrels, and tiny lizards rustling in the dry leaves on the forest floor, often confused with the not much larger rabbit-skinned squirrels. My wife may have seen one orang-utan, but if it occurred in our area at all it was certainly very rare. In compensation, the proboscis monkey was common and could be seen in troops varying from a few individuals up to 50 or more on any launch journey through the mangrove swamps at low tide. There was one old male who used to sit serenely only a few yards from us on his flat-topped mangrove bush (which exactly resembled one of the small-leaved widely-spreading bushes of China-type tea which until recently could be seen on many of the older Assam tea gardens) while his more nervous subjects raced from the mud to the safety of the taller mangroves. Proboscis monkeys were large and handsome clean-looking creatures in sharp contrast to the dirty little grey swamp monkeys who lived in similar places and were characteristically seen with an arm plunged up to the shoulder in the squelchy mud feeling for shell-fish. In the forest proper gibbons (perhaps of two species) were common, as also were several species of langur. We were fortunate to see a small group of the pig-tailed monkey.

Although the Borneo forests are not, any more than other tropical forests, the writhing nightmare of snakes imagined by so many stay-at-home Europeans, I had more narrow snake escapes in 9 months than in 14 years in Assam. There was the magnificent pit-viper of the species named after the gentleman whose name is spelt something approaching Wangel, banded in two shades of green and looking quite as venomous as, in fact, it was, which I nearly caught in my net with a *Euthalia*. It was lying coiled on a frond of rattan, and nothing I could do succeeded in making it move. This was in a particularly productive spot for butterflies which we visited several times a week. For the next 5 weeks it was always there in one of two places on either side of the narrow track. Once we had located it each day we felt fairly safe, but a day came in the fifth week when we could not do so; and when it reappeared on its first perch next day we regretfully decided that the only safe thing to do was to bring a man with a parang. Within a day of first finding this snake I met another of the same species, equally immobile and on a similar perch, but this second specimen I never saw again. That was a bad period because on the same day I had my foot lifted and was about to put it down when something made me hesitate . . . there was a long green snake (probably non-poisonous) lying across the track. I had the very greatest difficulty in moving it sufficiently to allow me to pass. This immobility seemed to be a feature of Borneo snakes, and rather a disturbing one, which caused us to lose many butterflies from watching too closely where we were treading instead of keeping our eyes on the main objective. On another occasion in very thick and dark secondary jungle I saw several fat caterpillars on a twig just in front of me. I was about to pick up and examine one of these when a movement to the left caught my eye . . . the bright blue flickering tongue of a snake whose folds round the twig I had mistaken for caterpillars. On the other hand, when actively hunting, snakes could be as active in Borneo as anywhere else—the one, for instance, that whistled past my cheek into a stream after a frog I had just disturbed.

We not only saw animals in the forest more frequently than in Assam, but we also from time to time had a curious feeling that the barriers between them and us were down, possibly because less intensive hunting through the ages has caused a less intense alertness towards humans. Two incidents will illustrate this. On an early morning walk along a disused timber road through the forest my wife saw a leopard cat with three kittens cross the track and go into the thick bushes. The kittens saw her and immediately emerged on to the track, approaching to within a few feet with every sign of friendliness. My wife had visions of the enraged mother and moved off, but the kittens followed her and in the end she had to shoo them off. This incident was all the more remarkable because the smaller cats are no more tractable in captivity in Borneo than in India. The other incident occurred during one of my midday collecting trips. I was in the Place of the Pit Viper when I became aware of a large animal coming at speed towards me down the track. Quite suddenly a sambar stag appeared, and as avoiding action was absolutely necessary I shouted at him. The shout registered, but not its source or direction, and for about 2 minutes he stood 8 feet from me, with his flank towards me, staring into the bushes on the right. Oddly enough he appeared to be using his eyes rather than his nose, otherwise at such a range he could hardly have failed to scent my sweaty body. It is difficult to describe the feeling of utter nakedness standing alone in the forest with not even a bush between myself and a large wild animal which I could have touched with my net. It is not easy to judge time under such circumstances, but after perhaps two minutes the sambar turned and started to move in my direction again. Another loud shout was necessary to avoid a collision, and this time he bounded off and away into the forest. Pig were noticeably more alert than most other animals, but even so there was always the danger of meeting them head-on on a narrow track. Near the end of our time in Borneo we were on a narrow track following the crest of a hill. To the right this fell away for 800 ft. in an apparently sheer rocky precipice, and at this particular place there was a view point a few feet wide and screened from the track by a few bushes. We had just reached this point when there was the thunder of hooves on the track ahead. It crossed my mind to move quickly to the view point and watch the sounder go by, but very fortunately I decided to shout instead and they changed course off into the forest on the left—'as large as landrovers' as my wife described them later. We found afterwards that a well-used pig track went over the edge of the precipice and obliquely down and I am quite sure that if I had obeyed my first impulse to stand aside on the view point we would have been swept over the side.

In all fields of Bornean Natural History an enormous amount yet remains to be learnt, and this applies even to birds, where Smythies's book is full of the challenging 'not recorded from Borneo' under the headings of habits, voice, and nidification. My wife was able to fill in a surprising number of gaps in such a short stay and will be writing these up elsewhere when she has a respite from cooking and washing. As a generalisation one might say that the tropical groups are bigger and brighter than in India and more numerous in numbers, and that there are fewer of the nondescript 'little brown jobs'. No apology is required for using a term originated by such an eminent ornithologist as Mr. Roger Peterson—nor would it be given after the comments frequently passed on some of my Lycaenids and Hesperids! Broadbills, trogons, woodpeckers, kingfishers, malkohas, and cuckoos are all conspicuous groups. Hornbills of 8 species make the forest resound with a variety of weird sounds from the blood-chilling roar of the rhinoceros hornbill (*Buceros rhinoceros*) to the demoniac laughter of the rarely seen but often heard helmeted hornbill (*Rhinoplax vigil*). This is an extraordinary creature with the two central tail feathers prolonged for 2 feet as a thin streamer. It is also the source of hornbill ivory, since the casque is of solid instead of cancellous bone, and one also finds a whole head with the casque beautifully and intricately carved by Chinese craftsmen. I have one such whose origin I cannot trace, but which was always reputed in the family to be a toucan and to have come from South America. So much for the accuracy of oral tradition. For sheer colour the pittas are hard to beat, and as in India, although reputedly not rare, they are very infrequently seen. One has the feeling that when the Creator came to the pittas he had become tired of the dull brown warblers and babblers and just tried to see how many and how bright colours could be painted harmoniously on to one bird. For grace and beauty of line I shall not forget the frigate birds which we occasionally saw off Wallace Bay, and for tameness the common sandpipers (*Tringa hypoleucos*) which were the common birds of our lawn from October to February, feeding unconcernedly by our windows and steps.

It was pleasant to be welcomed in Borneo by the call of the plaintive cuckoo (*Cacomantis merulinus*) and, more rarely and less melodiously than in Assam, the Indian cuckoo (*Cuculus micropterus*) —but one could hardly expect more of it in a land where the urgency to make more Pekoe does not arise. Apart from these and a few other old friends the common birds made a marked contrast. There are no sparrows in Borneo, their place being taken by the very common chestnut and dusky munias (*Lonchura malacca* and *L. fuscans*); the only myna is the grackle (*Gracula religiosa*), which normally keeps to the forest; the common house crow does not occur and the jungle crow (*Corvus macrorhynchos*) has only been recorded 4 times, their place being taken by another forest bird, the slenderbilled crow (*Corvus enca*). These gaps are all the more extraordinary when one considers the wide distribution and aggressive invasiveness of these birds.

Apart from check-lists and the inclusion of Bornean forms in works covering the whole of the Indo-Australian region there do not appear to be any books in English on the butterflies of Borneo. Even using papers such as Evans's recent monograph on the Oriental *Arhopala* is not entirely satisfactory without access to a museum when one is dealing with material which one hopes and expects to include new forms, and this must explain and excuse the ambiguity of the names I shall use. I cannot attempt a satisfactory identification of the mass of material I brought back until I can find the time to spend a month or more working at the British Museum.

My great love amongst the butterflies has always been for the Lycaenidae (and to a lesser extent for the Hesperiidae), and in the tropics particularly for the fascinating complex formerly known as the genus *Amblypodia*. The latter are very well represented in Borneo where there are 74 out of a total of 187 species for the whole Indo-Australian region, the individual butterflies of the group often being very plentiful indeed. Their favoured habitat was not the dark, bare floor of the primary forest but places where the loss of a few forest giants had allowed sunlight to reach the ground, and not too dense low leafy vegetation to flourish. Such conditions could be found where trees had fallen in primary forest, forming natural clearings, or where only a few of the larger trees had been felled a few years previously—though the latter areas could be very difficult for the collector due to the dense secondary growth of prickly rattan. Some of the very best places were beside newly made roads just inside the forest border, where extra light filtered through before the wound in the forest was covered by a dense leafy growth of granulation tissue, if I may use a medical parallel. Equivalent conditions could be found at a stage of felling when tracks had been driven through the forest and only a few trees felled, but these places had to be exploited quickly before they became an impenetrable mass of lopped and tangled branches in which it became impossible to collect. I could not decide whether the Borneo butterflies, and particularly the *Arhopala* group and the Hesperiidae, were faster and more restless than in Assam, or whether I had become slower, but we quite certainly found them more difficult to take.

Other inhabitants of the forest floor were a limited number of rather striking Satyrid species, Erycinids in great and exciting variety but not very great numbers, Amathusiids of many species, *Euthalia* spp. in great numbers, and (on the undersides of leaves) a single common species of *Eulacera*, an endless variety of Lycaenids, and disappointingly few Hesperids. Of the last mentioned family *Erionota* spp. (or perhaps only one species) were common and there were some exciting *Plastingia* spp. The Lycaenids included a few *Poritia* spp., a very great number of *Allotinus* of many species, *Jamides* spp., *Nacaduba* spp., and very many species allied to *Cheritra*, although only a few of the individual species of this group were common. Even during our few periods of really dry weather we very rarely found butterflies at damp places on the ground except to a limited extent in January and February, and never anything approaching a real congregation. Until the *Eupatorium* came out and introduced us to a new world of butterflies there were very few flowers to attract them except for two or three shrubs with insignificant white flowers which were favoured by *Plastingia* spp., as were similar plants in Assam.

The problem of Borneo, as of tall primary rains forest the world over, is the forest canopy. I did not regret the Papilios and Nymphalids (judging from the Sarawak Museum the latter were poor anyway), but I would have given a lot to have had one single day of the sort of weather conditions which would have driven the Poritiinae as well as *Tajuria* and *Pratapa* to the forest floor. The few I took of these groups were sufficient to keep me awake at night imagining the treasure, perhaps unknown to science, which I was sure must be in the canopy. The most surprisingly unrewarding habitat of all was gardens. A few common Papilios (with an occasional *Troides brookiana*), a few common Hesperids, the ubiquitous *Zizeeria maha* and *otis*, an occasional *Neptis* sp., and that was all.

I had been intending to conclude with a paragraph about the very happy race relationships and the peacefulness of this small territory, but the Brunei rising and its aftermath of rumbles from Indonesia have shown that so quickly do events move in the world to-day that it would be unwise to make remarks which may be nonsense by the time they appear in print.

The Indian Wild Ass: A Survey[1]

February 1962

BY

E. P. GEE

(*With a plate and one map*)

I. INTRODUCTION

Information on the present population and status of the Indian Wild Ass *Equus hemionus khur* Lesson, 1827, is scanty. For this reason I was prompted to undertake this brief fact-finding survey, especially as South African Horse Sickness[2] had been reported in that part of India recently. The International Union for the Conservation of Nature and Natural Resources sponsored my expedition, and the World Wildlife Fund very kindly paid my travelling expenses from the eastern part of India to the furthest western tip of the country.

The Report deals with the Indian Wild Ass. There are altogether in Asia five subspecies of *Equus hemionus* listed by Ellerman & Morrison-Scott (1951):

" *Equus hemionus hemionus* Pallas, 1775. Chigetai, Kulan, or Mongolian Wild Ass. Range: now apparently only found about Orok Nor and Zagan Nor, in Central Mongolia.

" *Equus hemionus onager* Boddaert, 1785. Persian Onager or Ghor-khar. Range: north-eastern parts of Persia and North-Western Afghanistan; Russian Turkestan, as above.

" *Equus hemionus khur* Lesson, 1827. Indian Wild Ass or Ghor-khar. Range: the Rann of Cutch, possibly Baluchistan, and South-Eastern Persia.

" *Equus hemionus kiang* Moorcroft, 1841. Kiang. Range: Ladak, Nepal, Sikkim, Tibet to Kukunor district.

" *Equus hemionus hemippus* I. Geoffroy, 1855. Range: Syrian Desert and adjacent parts. Possibly now extinct."

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[1] This survey was done for the Survival Service Commission of the International Union for the Conservation of Nature and Natural Resources. The report was first published in *Oryx* 7 (1): 9-21, April 1963, and is reproduced here by courtesy of the editor, the IUCN, and the author.—EDS.

[2] A virus disease of equines known from Africa for a long time. It spread to the Middle East a few years ago, and thence in 1959 to Pakistan. In April 1960 it began in Rajasthan in epidemic form, and by the end of the year over 9000 horses were reported to have died of it in various parts of India. Believed to be transmitted by midges of the genus *Culicoides*. Horses which recover from the disease are immune.—EDS.

The last mentioned is the Syrian Wild Ass which is considered by Talbot (1960) to be extinct. Of the wild asses of Egypt Talbot (1960) states: 'The wild ass was once found over much of the Eastern Desert, occasionally ranging further west along the Sudan border. At present the only concentrations known are in the isolated mountain groups north of the Sudan between the Nile and the Red Sea. They apparently are also partly feral, as they are considered the property of the local Bedouin.' And of the Nubian Wild Ass Talbot says: 'There is considerable doubt whether the animals now considered "wild asses" in Sudan are truly wild or merely "feral"'.

The Indian Wild Ass stands 11 to 12 hands (44 to 48 inches) high at the shoulder, whereas the local domestic donkeys only average 9¼ hands (37 inches). The wild ass is a bright yellowish sandy colour, with a short mane of dark chestnut colour and a line of the same colour extending down the back to the root of the tail. The lower parts are white. It has light fawn-coloured shoulders, saddle and sides to the rump, constituting an example of disruptive coloration. The ears are shortish, like those of a zebra.

The local domestic donkeys, on the other hand, are a dingy grey or dirty brown, with long ears From all accounts it is evident that not only does the wild ass never interbreed with the domestic donkeys, but it keeps entirely aloof and never mixes at all with them or with any other domestic animals. Domestic donkeys breed at any time of the year; but the wild ass is said to mate in August, September and October, and to bring forth young in July, August and September, the gestation period being eleven months. The call of the wild ass is shriller than that of a domestic donkey.

II. General Review and Summary of Report

The Indian Wild Asses are handsome, zebra-like creatures. They live in a unique habitat, which has to be seen to be believed.

The human population round the borders of the Little Rann of Kutch are peaceful, vegetarian folk, who do not molest the wild asses beyond driving them away from their cultivations when crops are raided. Previous estimates of the numbers of the wild asses were given in 'thousands'. I actually saw 214 in five days, and in close consultation with the local Forest Officers I estimate them now at 870. This lower figure may be due either to earlier exaggerations of their numbers, or to the fact that diseases may have taken a toll of them, or to both.

It is evident that a number of them died of *surra*[1] in 1958 and in 1960, and that at least some had died during the recent epidemic of South African Horse Sickness in November and December, 1961.

A census is urgently required of these rare creatures and should be repeated annually or bi-annually. All possible precautions should be taken by the authorities against diseases prevalent among domestic horses and donkeys.

III. HISTORY OF THE AREA

The Little Rann, which is the home of the wild ass, and most of the Great Rann, into whose eastern end a few asses may occasionally stray, used to form part of the princely state of Kutch. During this time, I understand, wild life was preserved by the rulers.

After India gained independence in 1947 this part of the country became the new State of Saurashtra. Later Saurashtra was merged with the larger Bombay State. More recently Bombay State has become divided into Maharashtra in the south and Gujarat in the north. So now Kutch is a district of Gujarat State.

The only serious expedition to obtain information on the wild asses was the one made by Sálim Ali in 1946. In his excellent and most valuable paper he has described how he visited the Little Rann from 24th February to 3rd March 1946, chiefly in order to obtain specimens for R. I. Pocock who was revising the Mammalia volumes of the FAUNA OF BRITISH INDIA. Sálim Ali again visited the Little Rann in 1960 to select places for field studies in bird migration.

Occasionally wild asses have been captured by running down and noosing from a moving vehicle, for zoos and to breed mules for the army. For example in February 1953, six were captured and sent to Jullunder. And in the old days, before the advent of the motor vehicle, spearing and capturing of wild asses were evidently done by relays of horsemen. No single horse, it is said, could keep up with them : only by changing horses and wearing down the wild asses could they be speared or captured. Gravid mares were the easiest to catch up with.

I was told that a pair was captured about thirty years ago by the princely family of Dhrangadhra, and trained to draw a carriage, and that they worked very well.

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[1] An arthropod-borne disease of horses and other animals caused by a protozoan blood parasite *Trypanosoma evansi*. The disease is almost always fatal to horses unless injection of arsenical preparations is given as a curative. Prophylactic doses give an immunity of about six months. Transmitted by various blood-sucking flies.—EDS.

IV. GEOGRAPHICAL AND ECOLOGICAL

The Little Rann of Kutch, an area of about 1000 square miles, is a salt-impregnated, flat waste, only a foot or two above sea level. It is sometimes described as an old estuary, from which the sea has receded. It is completely dried up from about November to June when motor vehicles can travel over most of the surface quite easily, avoiding the darker patches which might be soft.

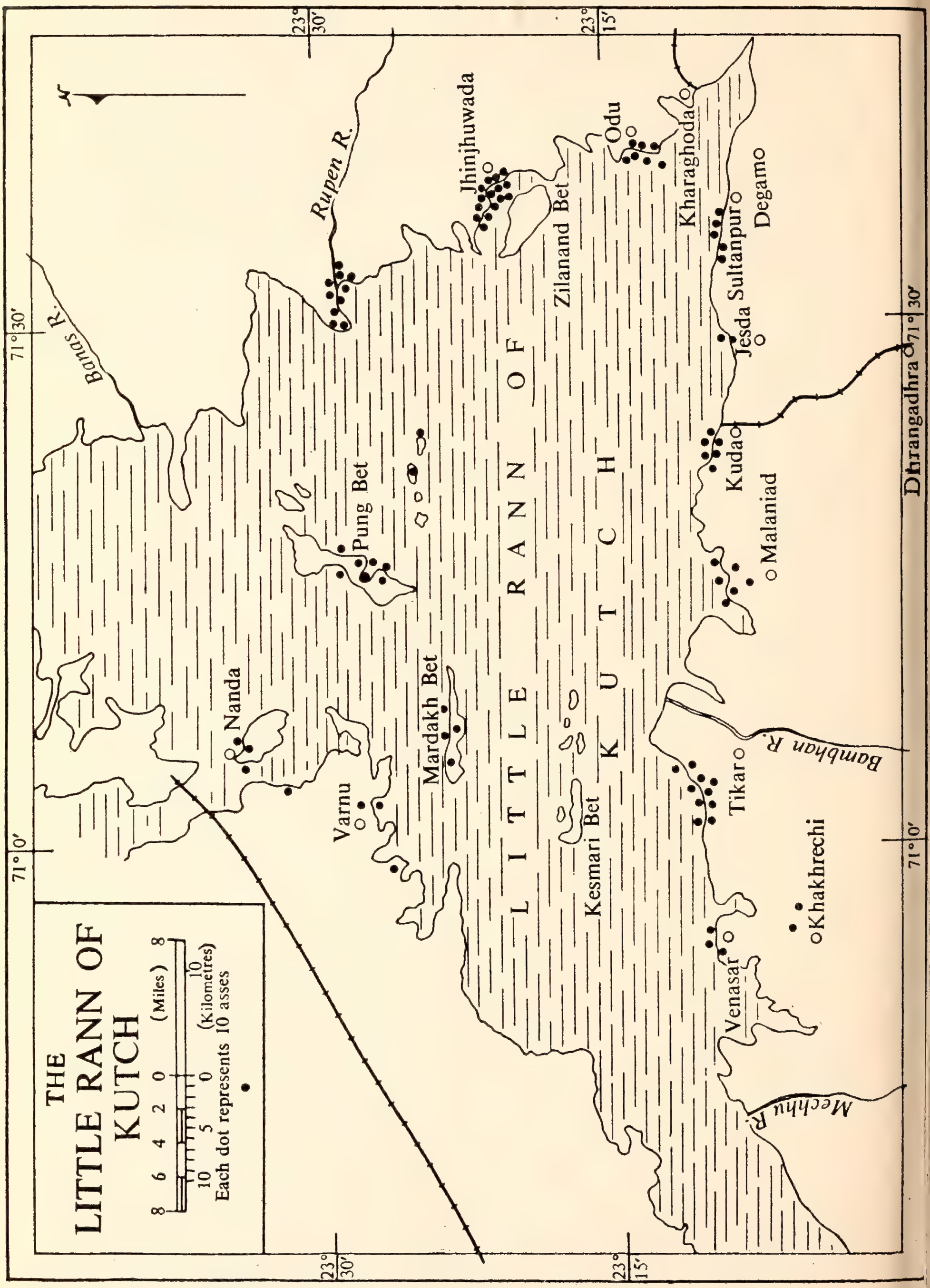
During the monsoon months from July to September, the discharge from the rivers Banas, Rupen and others, together with sea water blown up from the Gulf of Kutch in the south-west by the strong monsoon winds. cover the area with 1 or 2 feet of water and render it impassable. As this flat area is salt-impregnated, no vegetation of any kind can grow on it.

In the Little Rann there are several small islands or *bets* of higher ground, on which there is some sparse tree and grass vegetation. The wild asses graze on the *bets* and on the 'shores' of the mainland which borders the Rann.

The vegetation of the Rann and its environs is largely xerophytic, the average annual rainfall being only 13 inches. A common tree seen was the *babul*, *Acacia arabica*. Of grasses growing on the islands and shores of the mainland, I was informed that *thegado* (*Cyperus capillaris*) forms about three-quarters of the total. The grasses of the pasture lands of the villagers close to the Rann were said to be:

dabhado	*Eragrostis cynosuroides*	(30 per cent)
zinzvo	*Andropogon* spp.	(25 per cent)
kynyadi	*Andropogon laniger*	
khariga	*Sporobolus indicus*	
lampdos	*Aristida hystricula*	
kadvano	*Aeluropus villosus*	
fulisenur	*Eragrostis ciliaris*	
dhrokad	*Cynodon dactylon*	

The planting of 3000 acres per annum in the Rann area in Kutch Division (plus another 1000 to 2000 acres in Palanpur Division nearby) of *Prosopis juliflora* was started several years ago. These trees were introduced from Mexico into India some forty years ago for planting up saline tracts in the Punjab. They are being planted on the shores of the Rann as a wind-break, to improve land fertility and as firewood. The tree grows 20 to 25 feet in ten years, and flowers twice a year. Its dry seed pods, but not its leaves, are eaten by the wild asses, and the seeds (500 to an ounce) grow from the animals' droppings—thus aiding the forest staff in their work.


THE
LITTLE RANN OF
KUTCH
8 6 4 2 0 (Miles) 8
10 5 0 10 (Kilometres)
Each dot represents 10 asses
N
23° 30′
23° 15′
71° 30′
71° 0′
Banas R.
Rupen R.
Nanda
Varnu
Pung Bet
Mardakh Bet
Jhinjhuwada
Zilanand Bet
Kesmari Bet
LITTLE RANN OF KUTCH
Odu
Kharaghoda
Degamo
Sultanpur
Jesda
Dhrangadhra
Kuda
Malaniad
Tikar
Bambhan R.
Khakhrechi
Venasar
Machhu R.

These plantations on the mainland border of the Little Rann will eventually change the terrain and ecology considerably, with an effect on the wild asses which it is hoped will not be injurious in any way. It may be beneficial to them.

Near Kuda and even more so in the vicinity of Kharaghoda, to which places two railways run, are extensive salt workings. Holes are dug at the edge of the Rann, and the white saline water extracted and run off into pans. After evaporation the salt is collected, forming quite a big industry.

V. Administrative and Political

The responsibility for the preservation of wild life in the area, particularly the wild asses, mainly rests with the State Forest Department. In Gujarat there is a State Wild Life Officer, directly under the Chief Conservator of Forests.

The Divisional Forest Officer of Kutch Division, with headquarters at Bhuj, has jurisdiction over most of the Little Rann, up to 15 miles north of Jhinjhuwada. North of that point is Palanpur Division, under the DFO of that Division. Under the DFO of Kutch is a Range Officer stationed at Dhrangadhra, and under the latter officer is a Round Officer at Jhinjhuwada, as well as other subordinate staff. Their chief duty consists of planting and protecting the *Prosopis juliflora* trees.

The population of the environs of the Little Rann of Kutch, all Gujarati speaking, are vegetarian. They do not harm the wild asses or other wild life. In fact some of them are reputed to be so 'orthodox' that they are very reluctant to kill the locusts which devour their crops, but wish only to drive them away. One village, I was informed, does not allow even eggs to be eaten by others in the vicinity of their village. This belief in the sanctity of life has obvious advantages when the preservation of wild life is in question.

VI. General Account of the Survey

On 9th February 1962, a brief train stop at Baroda enabled me to discuss my proposed tour with Conservator of Forests, Shri S. R. Umbarje and the State Wild Life Officer, who came to meet me and brought my tour programme. This tour was to be rather short and circumscribed, I was informed, due to the fact that the DFO of Kutch and his jeep were required for the forthcoming Election. As there was no time to be lost, I continued my journey on the same train and arrived at Surendranagar about midnight. There I was met by Shri R. K. Rathod, DFO of Kutch, who had jeeped from Bhuj across the Little Rann to meet me. He had crossed the Rann via Kesmari Bet and other small *bets*, but had seen no wild asses. Shri P. G. Joshipura, Range Officer of Dhrangadhra, was also there to meet me.

At noon on 10th February we arrived at Dhrangadhra, which is very close to the Little Rann where we were to camp for at least one night. At 3 p.m. we jeeped the few remaining miles to the village of Kuda on the shore of the Rann and looked at a freshwater pond where a forest guard had seen 59 wild asses drinking on the previous afternoon. A little further on we saw herds of 22, 11 and 3 wild asses. They were very alert, usually keeping a sharp look-out for human approach.

I tried to observe carefully whether each herd had a leader or not, and particular 'look-out' animals. I noticed that two animals were slightly lame—probably due (I was told) to having stones thrown at them when they raided crops at night. As we drew near to each herd, it moved away from the undulating shore of the mainland, and made off on the flat and barren Rann.

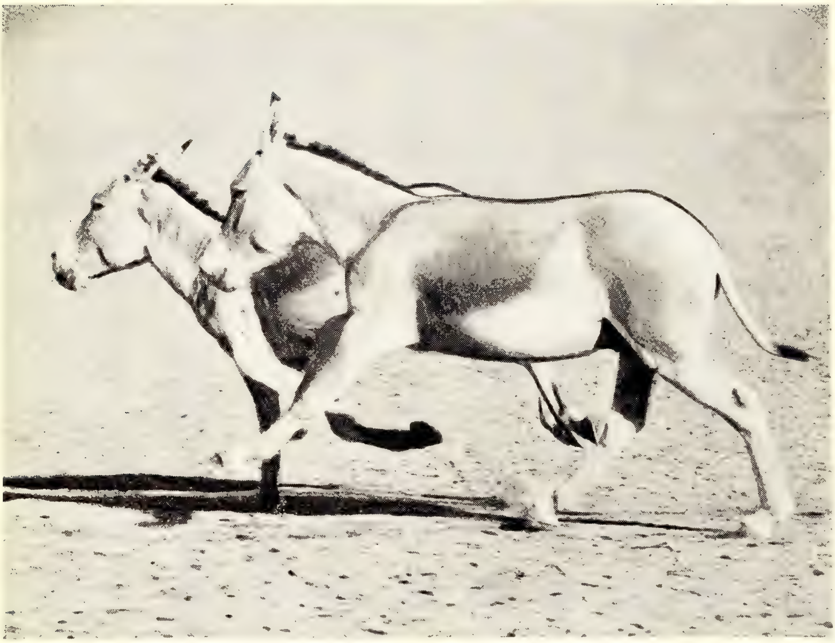
While we followed each herd as it galloped across the Rann, we were able to catch up quite easily in the jeep by doing 40 m.p.h. and then slowing down to 32 to 34 m.p.h. which is the maximum speed of the asses. The driver was instructed to drive to the left of each herd, so that I could observe and take photographs of the animals on my right.

The asses were not panicky—in fact they seemed almost to enjoy the gallop which is their normal method of evading enemies. Every now and then they would suddenly wheel to the right, away from the jeep, or to the left just in front of the jeep; and we had ourselves to stop and turn to the required direction if we wanted to follow them again. After a mile or two their speed would drop to about 28 m.p.h.

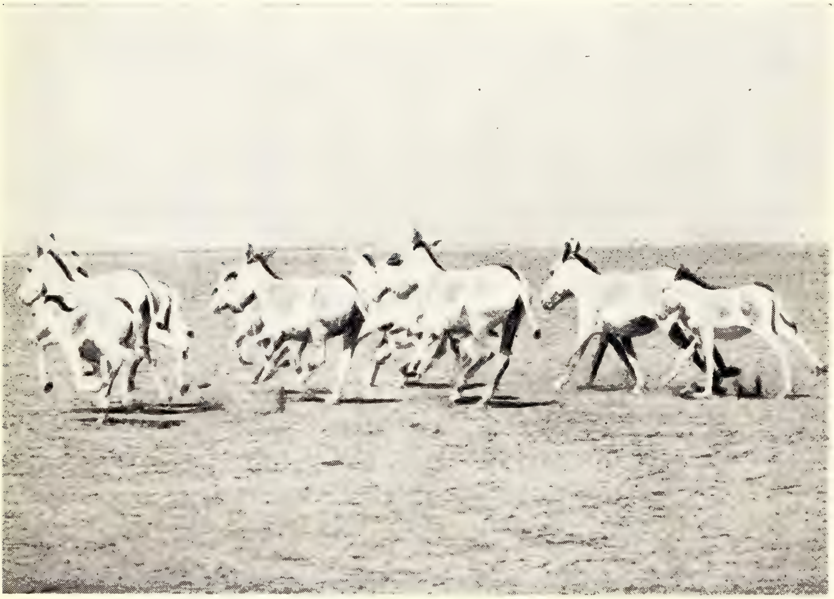
Whenever, during the course of our investigation we came to a sizeable village, I requested the DFO and RO to make inquiries about wild asses, especially whether any had died, and whether any domestic horses or donkeys had died from diseases. The information so collected is summarized later in the Report.

On 11th February we packed our belongings and set off on a journey along the south and up the east border of the Rann to the large *bet* of Zilanand (Jalander) and the nearby village of Jhinjhuwada.

The Indian Wild Ass



A close-up of two asses doing 32–34 m.p.h.



Young ones, about six months old, can be seen on the extreme left and right. Mirage effect in the distance, but no water.

Photos : E. P. Gee

Near Sultanpur we saw a herd of 22 wild asses, with two solitary ones wandering close by. I am not sure what is the reason for certain asses going solitary. Presumably they were oldish males, in either enforced or voluntary exile; but we noticed that they were always close to their herd and sometimes even rejoined it.

I tried to photograph one of these solitary ones by remaining hidden in a thorny thicket while the others of the party tried to drive the animal towards me. Several attempts ended in dismal failure, for the animal each time cleverly made off in another direction. Inevitably I had a feeling that I was the 'ass' and that the wild animal I was trying to capture on film was an alert and astute creature! Only by returning to the jeep and following the herd on to the Rann and photographing them at 32 to 34 m.p.h. at 1/1000 second shutter speed was I able to regain some of my self-respect! I was told by a smiling informant that on a certain occasion the local police had been detailed to drive the asses away from the cultivations they were raiding. The asses galloped out in front to the Rann with the police following behind in jeeps. On the return journey, which took place immediately, the order was reversed: the police were in front and the asses behind!

At Degam village we met the *sarpanch* (president of the village council) and the *panchayat* (council members), from whom we got much information. It was particularly fortunate that I could meet these men, as I was able to learn from them what the feelings of the local people were regarding the wild asses. With the help of the DFO and RO, who did the English-Gujarati Gujarati-English interpretation, I explained to them the value of the wild asses as a rare species found only in their part of India; how the animals could be a source of pride to them, and that they could perhaps tolerate some damage to their crops, in order that a valuable species might survive.

In other parts of the country, I explained, the lions of the Gir Forest caused some destruction to cattle, and the rhino of Assam and West Bengal raided rice fields—but the local people commendably tolerated this. The reactions of the council members were very gratifying : the *sarpanch* confirmed that the villagers only drove away the wild asses from their crops at night, and never harmed the animals. They were proud to be the only custodians of a rare species of India.

We drove past the extensive salt workings near Kharaghoda, and then, further north near the southern tip of Zilanand Bet, saw 60 wild asses in herds of 10, 7 and 43. In this area the mirage effects in the shimmering heat were even more striking than previously : asses seemed to be walking in water complete with their reflections, and the *bets* seemed real islands in a real sea—though every yard of the Rann was dusty dry.

The next day, 12th February, we explored fresh terrain near Zilanand Bet on the north and east sides, and encountered wild asses in groups of 8, 7, 45 and 22. I found a carcase of a wild ass, about two or three months old, which I photographed. We glimpsed a frightened blackbuck—the only one on our tour. Earlier, on the mainland, we had seen two or three nilgai.

In Jhinjhuwada village we met, among others, the Veterinary Assistant and were able to get more authoritative information about deaths from diseases of wild asses, domestic horses, and donkeys during the past few years.

On the morning of 13th we met the Vet. again, and also the members of the village council. We obtained more information and as at Degam spoke about preservation of the wild asses—with very gratifying response. I feel certain that direct personal contact with these village *panchayats* is a very effective way of putting across the reasons and need for wild life preservation.

I longed for the opportunity to explore further, and to visit Pung Bet, but our time was circumscribed by the forthcoming Election for which the DFO had to return. So in the afternoon we jeeped back to Dhrangadhra by the route along which we had come. In the evening I made a special point of contacting the Veterinary Officer of Dhrangadhra, who had 60 villages under his charge. He informed me that from 15th November to 7th December 1961, no less than 392 domestic horses (and some donkeys) had been inoculated against South African Horse Sickness, a dose giving six months' immunity and costing Re. 1 each at Government expense. The vaccine is prepared in the brains of mice, one mouse providing 20 doses of 5 c.c. each.

It was interesting to learn that it was proposed to inoculate all domestic horses and donkeys by the end of September, 1962, for this disease breaks out in epidemic form from the end of the monsoon, chiefly in November.

During my survey I was able to contact the local military, including the Commanding Officer, for firing practice is often done at Kesmari Bet near Tikar. They stated that they had never seen any wild asses in that area, nor had they shot at any.

On 14th we paid a second visit to Kuda and its environs, and set up a hide near a freshwater drinking place in order to get a close-up view of the asses moving about freely and undisturbed. . A herd could be seen about half a mile away, keeping a sharp look out in all directions. The animals were much too clever to approach the hide. Once again a very strong conviction obsessed me that I, crouching uncomfortably in the hide in the heat of the day, was the 'ass' and once again my self-respect could only be restored by following the herd in the jeep. The usual thing happened: the asses galloped away to the safety of the Rann, and at 32 to 34 m.p.h. I took photographs of them at 1/1000 second shutter speed. They numbered 48 this time, but of these 36 may have been seen by us on the first day, so I added only 12 to the score!

Thus ended my brief field observations of the wild asses in their unique habitat.

VII. DISTRIBUTION, STATUS, AND FUTURE OF THE INDIAN WILD ASS

Distribution. Wild asses appear to have once had a fairly wide distribution in the dry regions of North-West India and West Pakistan. During the last century they existed as far north as Jaisalmer and Bikaner of Rajasthan (India), and Sind and Baluchistan (West Pakistan).

Talbot (1960) was mistaken when he wrote of the wild asses: 'Most of them live in the Great Rann of Kutch, northward from Bombay . . .'. As far as I can ascertain, there are no wild asses actually in the Great Rann. Only a few stragglers are reported to pass along the eastern border of the Great Rann, presumably on their way to and from West Pakistan where a few animals have been reported.

I have been trying to check these reports of wild asses in West Pakistan, and have been in correspondence with Dr. A. R. Ranjha, Director of the Zoological Survey Department of Pakistan. From him has come information that a local *shikari* (sportsman) shot one in 1959, and that the *shikari* has stated that wild asses are found in the Nagarparkar and Chacro *tehsils* of Tharparkar District, which adjoins the (Great) Rann of Kutch on the Pakistan side, and are hunted by *shikaris*. The *shikari* also reports that between the Indian and Pakistani outposts the wild asses come over to the Pakistan side for grazing; that they move back to the open spaces of the Rann of Kutch in the morning, and live and breed on the Indian side of the border because they feel safe and free from molestation there; that no data regarding their population is available.

From Baluchistan the information is that the wild ass is no longer found at Tallab on the border of Kharan District, that it was 'originally met with in Balgatar (Makran) but is no longer found in the contiguous areas of Buleda and Zamran . . . it was formerly met with between Panjgur and Sohtgaon areas but is now rare'.

Status. In 1946 Sálim Ali estimated the population of the Indian Wild Ass in the Little Rann of Kutch as 3000 to 5000. Later in 1960 (*in litteris*) he considered that the estimate given by the Range (Round ?) Officer of Jhinjhuwada of 2000 animals as 'probably not unreasonable'. Wynter-Blyth (1956) described the wild ass as 'more than abundant' and 'in his thousands' and 'undoubtedly very common'. When I mentioned these figures to the DFO and RO who accompanied me on my expedition, they both expressed surprise and gave much lower estimates.

After our tour along the southern and eastern borders of the Little Rann, where the District Forest Officer, the Round Officer, and I saw a total of 214 wild asses (Kuda 36, Sultanpur 24, South Zilanand 60, East and North Zilanand 82 and Kuda 12), the three of us sat down and made an estimate. They did the actual estimating, locality by locality. I was a 'sobering influence' on them, requesting them to be careful and conservative. Their estimate, which I accept is as follows:

Khakhrechi . .	20
Venesar . . .	30
Tikar . . .	100
Malaniad . . .	60
Kuda . . .	60
Jesda . . .	20
Sultanpur . .	50
Odu . . .	70
Jhinjhuwada and Zilanand Bet . .	150
Rupen River . .	100
Pung Bet and Kutch Mainland .	200
Total . . .	860

To this I have tentatively added 10 for the border of the east of the Great Rann and West Pakistan, making a grand total of 870.

Grand Total . .	870

In the Little Rann of Kutch the wild asses appear to be secure from danger as far as molestation and killing by man are concerned. Wolves are the only potential predator enemy, and these appear to have become very rare indeed.

Wild asses show a strong partiality to crops, raiding (in order of preference) gram, wheat, cotton, millet and *jowar*. They get driven away from the fields when they enter them at night, and an occasional ass might become temporarily lame from stone throwing.

Although they have to compete with vast numbers of domestic cattle, sheep and goats for the little grass that there is, the asses are probably accustomed to such conditions and looked rotund and healthy in condition.

Diseases. The chief danger, as I see it, to the wild asses is undoubtedly their susceptibility to diseases contracted from domestic stock. Sálim Ali (1946) stated 'No epidemics appear to be known among the wild asses'; but in August, 1960, he informed me (*in litteris*): 'One disturbing bit of information the Ranger gave me is that quite recently 25 to 50 (to his knowledge) asses had died of a mysterious illness. The animals "turned round and round and fell dead".'

While in Jhinjhuwada we checked and confirmed this occurrence of 1960. In fact one forest guard stated categorically that in April to May 1960, he saw 30 dead carcases of wild asses, and heard of about 120 more; but no report had been made to higher authority. From the symptoms described, the Veterinary Assistant at Jhinjhuwada said this disease was almost certainly *surra,* and this was later confirmed by the Veterinary Officer of Dhrangadhra. The latter officer also stated that in 1958 at Jhinjhuwada six domestic horses died of *surra* and *surra* had been confirmed in two dead wild asses which had been brought in to him for post-mortem examination. There are no large scale inoculation arrangements for combating *surra*: apparently each dose costs Rs. 3.50 and the owner has to bear the expense.

Now for South African Horse Sickness. This disease apparently swept through the area under review in November and December, 1961. Personal inquiries at some of the villages we visited revealed the following deaths:

Village	*Horses*	*Donkeys*	*Wild Asses*
Kuda . . .	—	—	2
Nirali . . .	10-11	0	3
Degam . . .	12	0	5-6
Odu . . .	15	—	—
Jhinjhuwada . .	10-15	0	1

The Veterinary Officer at Dhrangadhra stated that as far as he knew wild asses rarely get anthrax and they are not susceptible to foot and mouth disease, hæmorrhagic septicæmia or rinderpest. Also that he had records of 78 horses and 6 donkeys dying of South African Horse Sickness in November and December 1961, but no knowledge of wild asses dying of this disease as these wild animals did not come within his purview. Now it appears that at least some wild asses died at the time that South African Horse Sickness was prevalent and that no note was taken of this by the authorities.

Future. A careful system of reporting outbreaks of diseases among domestic horses and donkeys, and deaths of wild asses at the same time, needs to be instituted. Prophylactic measures against such outbreaks require the urgent attention of the authorities. It is gratifying to learn that steps are intended to be taken to immunize horses and donkeys against South African Horse Sickness.

A census of the wild asses should be conducted every year, or at least every two years. As the country is all open and the animals easily seen, this should not be difficult. The possibility of undertaking an aerial census should not be overlooked, and the co-operation of the Indian Air Force or of private flying clubs should be sought.

Wild asses, if captured young, seem to do well in captivity. Harper (1945) records that the breeding of captive wild asses from India was successfully carried out in Paris from 1842-1849; and that out of nine foals produced during this period, six survived in 1849. I saw a male ass in the Junagadh Zoo, and suggested that a female be procured and attempts be made to get them to breed there. In the Ahmedabad Zoo I saw a pair together in one enclosure, and an odd one by itself in another. The latter could well do with a mate.

It would be a reasonable conservation measure, in my opinion, to capture departmentally a few pairs of young wild asses and keep them in good zoos with a view to studying their life history and breeding them—in case anything serious should happen to the ones in the wild state.

VIII. RECOMMENDATIONS

I make the following recommendations:

1. That the Indian Wild Ass be officially placed on the list of fully protected animals by the Gujarat State Government, and that it be constituted State property wherever found.

2. That permits for capture of young ones be issued only for special reasons, for good zoos, and only by the Chief Conservator of Forests, Gujarat.

3. That a physical count (census) be done as soon as possible, and repeated annually, or at least at regular intervals of two years or three years.

4. That the Veterinary Department be moved to inoculate all domestic horses and donkeys in the area against South African

Horse Sickness each year by the end of September, and also against *surra* if possible.

5. That all outbreaks of diseases or other occurrences among the wild asses be observed and reported by the authorities concerned.

6. That a few pairs of young ones be humanely captured and kept in good zoos, for study and for breeding.

7. That a complete ecological study of the Indian Wild Ass and its environment be conducted by competent persons in the near future.

IX. ACKNOWLEDGEMENTS

I owe my sincere thanks to Shri Hari Singh, Chief Conservator of Forests, Gujarat State, for welcoming my offer to come and investigate the Indian Wild Ass and for extending his Department's full co-operation to me. Particularly I am grateful to the DFO of Kutch, Shri R. K. Rathod and his RO, Shri P. G. Joshipura, for making all the detailed arrangements of the expedition, for accompanying me, and for further demonstrating that Gujarati hospitality has to be experienced to be believed.

I am grateful to the villagers who replied patiently to all our cross-questioning, and especially to the presidents and members of the village councils of Degam and Jhinjhuwada for their interest and for their offers of continued help in preserving the wild asses. (I suggest that copies of this Report be sent to all village councils of the area in which the wild asses occur.)

I thank the Veterinary Assistant of Jhinjhuwada, and the Veterinary Officer of Dhrangadhra, Dr. V. K. Poundarik, for all the information they gave me.

I also thank Dr. A. R. Ranjha, Director of the Zoological Survey Department of Pakistan, for so promptly and fully replying to my queries about the existence of the wild ass in that country.

Finally I must again express my indebtedness to the IUCN who sponsored my investigation, and to the World Wildlife Fund for paying my travelling expenses to and from the Little Rann of Kutch.

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A Botanical Tour to Trikuta Hills

BY

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On the north-eastern horizon of Jammu-Tawi peeps a group of three peaks, commonly known as Trikuta Hills, under which lies the cave of the sacred shrine of Shri Vaishnodevi. Situated at 5300 ft. above sea-level, the shrine is held in high esteem by the Hindus, and people from all over India come to the holy cave to worship. Devotees have to ascend to 6150 ft. and then to descend about 750 ft. on the other side of the hill, where a narrow 100 ft. long entrance leads to the Deity. The pilgrimage attended by tens of thousands of people every year continues from mid-October to December or even January, till heavy snow-fall makes access difficult.

The authors, who were on a study tour to Trikuta Hills while making their botanical collections, were asked many questions about the utility of the plants growing all along the way to Shri Vaishnodevi. This prompted them to write the present paper.

Situated at 34° N., 74° E., Trikuta Hills are included in the 'Outer Hills' division of geographical divisions of the Jammu and Kashmir State. A large portion of this 'Outer Hills' lies at an altitude between 2000 and 4000 ft., but the highest among the three peaks reaches a maximum height of 7000 ft. With such variations in altitude, wide differences in temperature are inevitable and climatic conditions differ widely. At the higher elevations on the mountain slopes and 'margs' the climate is cold, and at the lower elevations on the plains it is warmer. July-August receive the maximum rainfall, the average annual rainfall ranging between 55 in. and 60 in.

Katra, the base of the hill, is 29 miles north-east of Jammu-Tawi. It is connected by a first class tarred road with the main Jammu-Srinagar road. From Katra, two routes lead to the hill, a bridle-path (11 miles) and a foot path (7 miles) which is very steep.

The botanical tour was undertaken along the bridle-path in the month of November, 1960.

As the motor route leads from Jammu (900 ft.) to Ramnagar on the main Jammu-Srinagar road, the forest flora comes into view. The *Phulai-Khair* (*Acacia modesta* Wall.-*A. catechu* Willd.) association dominates and at some places is interrupted by the deciduous *Kachnar* (*Bauhinia variegata* Linn.) trees. Among the other trees and shrubs which go into the formation of the forest flora are *Harsinghar* (*Nyctanthes arbor-tristis* Linn.), *Ber* (*Zizyphus mauritiana* Lamk.), and *Lantana camara* Linn. The white-flowered *Vasaka* (*Adhatoda vasica* Nees) forms the forest undergrowth, and the ground cover is composed of such herbaceous plants as *Kanjuna* (*Commelina obliqua* Buch.-Ham. ex D. Don), and *Gul-doda* (*Leucas cephalotes* Spreng.).

Nearing Nagrota (1100 ft.) the frequency of *Phulai-Khair* association is replaced by the *Khair-Tali* (*Dalbergia sissoo* Roxb.) association. Much of the greenery of this area is contributed by many large shrubs, which cover most of the otherwise naked area. Common among them are *Dhawi* (*Woodfordia fruticosa* Kurz), *Villebrunea frutescens* Blume, *Carissa opaca* Stapf, and *Colebrookea oppositifolia* Smith, while *Adhatoda vasica* Nees and *Lantana camara* Linn. grow in abundance on both sides of the road.

At Nagrota (1300 ft.) instead of much greenery there is scanty vegetation. The lower slopes, or popularly called dragon peaks all around are strewn with boulders and in between them grow *Sanatta* (*Dodonaea viscosa* Linn.) and *Carissa opaca* Stapf. The former species, which is the commonest and most conspicuous plant in the area, becomes gregarious at places, often to the exclusion of other species. *Dodonaea* and *Carissa* are abundant all around, while *Bana* (*Vitex negundo* Linn.) with its blue-purple flowers is also observed growing in small patches.

Further onwards, at Nandini (1800 ft.) the climatic conditions change to that of moist locality, where stunted trees of Chir pine (*Pinus roxburghii* Sar.) make their appearance.

Higher up about 2000 ft. above sea-level at Domel, the route deviates from the main Jammu-Srinagar road, and zigzags further in the east for about 8 miles, where Chir forms pure forest over extensive areas and is tapped for resin. While Chir pines confine themselves to the hill-tops and other similar habitats, *Wendlandia exserta* DC. grows in abundance on the steep rocky slopes. The undergrowth beneath the Chir is mainly of evergreen shrubs like *Dodonaea viscosa* Linn., *Colebrookea oppositifolia* Smith, *Carissa opaca* Stapf, and *Sakena* (*Indigofera pulchella* Roxb.), and the forest floor is covered with *Lotus corniculatus* Linn., *Desmodium triflorum* DC., and *Oxalis corniculata* Linn.

Further onwards, nearing Katra, at an altitude between 2200 and 2700 ft., the vegetation again becomes scanty and is represented by the fleshy cactus-like *Dudal-petal* (*Euphorbia royleana* Boiss.).

The town of Katra has no special features of vegetation, except for much biotic interference which has resulted in extreme dry conditions. The major components of the vegetation in this area are such armed trees and shrubs as *Zanthoxylum*, *Zizyphus*, *Euphorbia*, and *Lantana* species.

The path from Katra (2700 ft.) to the steady flowing stream Banganga (2200 ft.) is a steep descent of about 500 ft. through barren limestone rocks and, among the various sedges and grasses that line the way, the commonest are *Kai* (*Eriophorum comosum* Nees) and *Chrysopogon aucheri* (Boiss.) Stapf.

Climbing the hill begins at Banganga itself and requires about six hours' steady climb through an eleven-mile long winding path. Considerable change in the main composition of the vegetation is observed at different levels on the route. As the flora changes with the change in altitude, new and beautiful flowers come into view. The vegetation on the Banganga-Adhkanwari (2200-4300 ft.) sector shows remarkable uniformity and consists mainly of shrubs and herbs. Trees are few in this area and wherever present are represented by *Simul* [*Salmalia malabarica* (DC.) Schott. & Endl.], *Ber* (*Zizyphus mauritiana* Lamk.), and *Mallotus philippinensis* Muell.-Arg. while among the shrubby elements cactus-like *Euphorbia royleana* Boiss. grows in abundance on hilly slopes, and *Timru* (*Zanthoxylum alatum* Roxb.) along with *Berberis lycium* Royle, *Debregeasia hypoleuca* Wedd., and *Boehmeria platyphylla* D. Don, on the exposed rocky surfaces; the shrubby element is composed of the yellow-flowered *Crotalaria sericea* Retz. and the blue-flowered *Hamiltonia suaveolens* Roxb. The appearance of dense green vegetation in the locality is due to a number of climbers and twiners that interweave between the trees and shrubs, namely *Butterbail* (*Cissampelos pareira* Linn.), *Chambeli* (*Jasminum grandiflorum* Linn.), and a yellow-flowered *Clematis* Linn. Pink-flowered *Micromeria biflora* Benth. along with *Dicliptera roxburghiana* Nees, and *Galium rotundifolium* Linn., inhabit the moist crevices of the rocks, while the common lithophytes in the area are *Polygala abyssinica* R. Br., *Gidar-tamaku* (*Verbascum thapsus* Linn.), species of *Conyza* and *Lactuca* Linn., *Pennisetum orientale* L. C. Rich., *Arundinella nepalensis* Trin., and *Arundinella pumila* Steud.

As the predominantly shrubby and herbaceous vegetation of the previous area is gradually passed, at an elevation of 4400 ft. (Hathimatha-Chhangichhat sector) the Chir pines become more and more dominant. Shrubs are few and are represented by the yellow-flowered *Hypericum cernuum* Roxb. and the pale purple-flowered *Lespedeza juncea* Pers. on hill slopes, while the herbaceous elements are represented by the cream-coloured *Dipsacus inermis* Wall., dark blue *Gentiana kurroo* Royle, along with many members of the Compositae family, the commonest among which are the white-flowered *Anaphalis triplinervis* Sims ex C. B. Clarke, purple-flowered *Artemisia roxburghiana* Besser., and the pale yellow-flowered Phoss (*Cnicus wallichii* DC.).

The path from Chhangichhat (the highest point at 6150 ft. above sea-level) to Vaishnodevi is a steady descent on the other side of the hill to 5300 ft. at Vaishnodevi. The open dry vegetation of the previous zone is gradually replaced by the moist evergreen vegetation thickly covering the soil. While the Conifer trees occupy the hill-tops, the lower slopes have a rich representation of *Ilex dipyrena* Wall., *Cedrela serrata* Royle, *Litsaea umbrosa* Nees, and many other trees of the temperate climate. *Sarcococca pruniformis* Lindl., along with *Senecio rufinervis* DC. and *Lonicera quinquelocularis* Hardw., form the undercover and common climbers like *Smilax aspera* Linn., *S. parvifolia* Wall., and *Dioscorea deltoidea* Wall. add to the density of the flora. *Hedera helix* Linn. with its green berries is a common sight on the trees. Multicoloured patches of low and prostrate herbs like *Triflora* Linn., *Wulfenia* Jacq., *Potentilla* Linn., and *Polygonum* Linn. along with abundant mosses and ferns cover the floor and the white-flowered *Pissumar* (*Boeninghausenia albiflora* Reich.) imparts a characteristic beauty to the locality.

PLANTS OF ECONOMIC IMPORTANCE

A careful perusal of the census list of the collected plants will show that about 50% of the plants growing in this region are, or are reputed to be, of economic importance.

The tubers of *Dioscorea deltoidea* contain 4.8% of Diosgenin which forms the base material for the manufacture of cortisone and other sex hormones. The tubers are in considerable demand by the pharmaceutical industry.

The roots of *Cissampelos pareira* contain among other alkaloids a working percentage of hyatin which possesses and almost equal degree of curari-form activity to that of d-tubocurarine.

The roots, leaves, and flowers of *Adhatoda vasica* are used in Indian medicine for treatment against cough, bronchitis, asthma, and phthisis. An active principle vaccine isolated from this plant is of therapeutic use. Similarly *Pinus roxburghii* is utilized for tapping resin for the manufacture of rosin and turpentine and this is a well-established industry of the State. In addition to the commercial importance of the timber, the pine needles yield an essential oil which can be used as a disinfectant. The exhausted needles after a simple treatment can be used as fibre for making ropes, mats, etc. The flowers of *Jasminum grandiflorum*, *Nyctanthes arbor-tristis*, *Lantana camara* yield essential oils for cosmetic or other purposes. The essential oils from *Zanthoxylum alatum*, *Vitex negundo*, and *Boeninghausenia albiflora* have reputed insecticidal and insect-repellent properties which can be usefully employed as an important ingredient with other disinfectants or insecticides. Some plants, such as *Acacia* sp., yield tanning material while others such as *Rumex* sp. and *Cassia* sp. contain chrysophanic acid. The above plants have known active principles with therapeutic activities. Many others in the list which have not been worked out chemically may yield still more interesting results if systematically analysed. Plants which are of established or possible economic importance are marked with asterisks in the census list.

SYSTEMATIC CENSUS

RANUNCULACEAE

* **Clematis graveolens** Lindl.
Banganga-Adhkanwari zone, 2700 ft.
A climbing shrub with pale-green flowers.

Thalictrum pedunculatum Edgew.
Banganga-Adhkanwari zone, 4300 ft.
A slender herb with greenish flowers.

MENISPERMACEAE

* **Cissampelos pareira** Linn.
Ver. Name : *Butterbail*
Banganga-Adhkanwari zone, 4300 ft.
A climbing shrub with fruits.

BERBERIDACEAE

Berberis lycium Royle
Ver. Name : *Simblu.*
Banganga-Adhkanwari zone, 4300 ft.
An armed shrub with fruits.

POLYGALACEAE

Polygala abyssinica R. Br.
Banganga-Adhkanwari zone, 4300 ft.
An erect herb on rocks with purple-marked pink flowers.

Polygala erioptera DC.
Ramnagar, 1000 ft.
An erect herb with yellow flowers.

CARYOPHYLLACEAE

Silene falconeriana Benth.
Bhairoghati-Vaishnodevi zone, 5900 ft.
An erect herb with purple-marked green flowers.

HYPERICACEAE

Hypericum cernuum Roxb.
Hathimatha-Chhangichhat zone, 6150 ft.
A shrub with bright yellow flowers.

MALVACEAE

* **Salmalia malabarica** (DC.) Schott. & Endl. *Bombax malabaricum* DC.
Banganga-Adhkanwari zone, 2750 ft.
A tall deciduous tree common in the area.

TILIACEAE

* **Corchorus aestuans** Linn.
Ver. Name: *Titapat.*
Ramnagar, 1100 ft.
A tall herb with orange flowers.

GERANIACEAE

* **Oxalis corniculata** Linn.
Ver. Name: *Amlika.*
Domel, 2000 ft.
A prostrate herb among grasses with yellow flowers.

RUTACEAE

* **Boeninghausenia albiflora** Reich.
Ver. Name: *Pissumar.*
Bhairoghati-Vaishnodevi zone, 4300 ft.
A much-branched shrub with white flowers.

* **Zanthoxylum alatum** Roxb.
Ver. Name: *Timru.*
Banganga-Adhkanwari zone, 4300 ft.
A shrub armed with prickles.

MELIACEAE

Cedrela serrata Royle

Ver. Name : *Tuni.*
Bhairoghati-Vaishnodevi zone, 5900 ft.
A medium-sized tree common in the area.

ILICINEAE

Ilex dipyrena Wall.

Ver. Name : *Kanderu.*
Bhairoghati-Vaishnodevi zone, 5300 ft.
An evergreen tree with scarlet fruit.

RHAMNACEAE

* **Zizyphus mauritiana** Lamk. *Z. jujuba* Lamk.

Ver. Name : *Ber.*
Ramnagar, 1000 ft.
An armed tree common in the area.

AMPELIDACEAE

* **Leea robusta** Roxb. *L. aspera* Wall.

Banganga-Adhkanwari zone, 4600 ft.
A straggling shrub with black fruits.

SAPINDACEAE

* **Dodonaea viscosa** Linn.

Ver. Name : *Sanatta.*
Nagrota, 1200 ft.
An evergreen shrub, abundant throughout the area.

LEGUMINOSAE

* **Crotalaria sericea** Retz.

Ver. Name : *Jhunjhunia.*
Banganga-Adhkanwari zone, 2700 ft.
An erect villous herb with yellow flowers.

* **Trifolium pratense** Linn.

Bhairoghati-Vaishnodevi zone, 5300 ft.
A procumbent herb with pink flowers in terminal corymbs.

* **Lotus corniculatus** Linn.

Domel, 2000 ft.
A prostrate herb with greenish yellow flowers.

* **Indigofera pulchella** Roxb.

Ver. Name : *Sakena.*
Domel, 2000 ft.
A deciduous shrub. Common in the area.

* **Tephrosia purpurea** Pers.
Ver. Name : *Sarbank.*
Banganga-Adhkanwari zone, 3900 ft.
An undershrub with fruits.

Lespedeza juncea Pers.
Hathimatha-Chhangichhat zone, 6150 ft.
An undershrub with pale purple flowers.

* **Desmodium gangeticum** DC.
Ver. Name : *Kanthi*
Ramnagar, 1100 ft.
A slender suberect shrub, with fruits.

* **Dalbergia sissoo** Roxb.
Ver. Name : *Tali.*
Nagrota, 1100 ft.
An erect tree, with pods.

* **Cassia tora** Linn.
Ver. Name : *Herwanh.*
Ramnagar, 1100 ft.
A glabrous annual weed, with long slender pods,

* **Cassia mimosoides** Linn.
Ramnagar, 1100 ft.
A diffuse perennial herb, with orange flowers.

* **Bauhinia vahlii** W. & A.
Ver. Name : *Bari Kachnar.*
Ramnagar, 1100 ft.
A climbing tree.

* **Bauhinia variegata** Linn.
Ver. Name : *Kachnar.*
Ramnagar, 1100 ft.
A medium-sized deciduous tree.

* **Acacia arabica** (Lamk.) Willd.
Ver. Name : *Kikar.*
Ramnagar, 1100 ft.
A medium-sized tree with yellow flowers.

* **Acacia catechu** Willd.
Ver. Name : *Khair.*
Nandini, 1800 ft.
A medium-sized deciduous tree, with pods.

Acacia modesta Wall.
Ver. Name : *Phulai.*
Ramnagar, 1000 ft.
A medium-sized tree with pods.

ROSACEAE

Rubus ellipticus Smith

Banganga-Adhkanwari zone, 4200 ft.
A straggling armed shrub.

Rubus lasiocarpus Smith

Bhairoghati-Vaishnodevi zone, 5700 ft.
A straggling armed shrub.

*__Potentilla supina__ Linn.

Bhairoghati-Vaishnodevi zone, 5300 ft.
A weak annual herb with yellow flowers.

COMBRETACEAE

* **Terminalia belerica** Roxb.

Ver. Name : *Bahera.*
Nandini, 2000 ft.
A large deciduous tree with fruits.

LYTHRACEAE

* **Woodfordia fruticosa** (Linn.) Kurz. *W. floribunda* Salisb.

Ver. Name : *Dhawi.*
Ramnagar, 1100 ft.
A pubescent shrub, common on rocks.

ARALIACEAE

* **Hedera helix** Linn.

Ver. Name : *Banda.*
Bhairoghati-Vaishnodevi zone, 5900 ft.
A creeping shrub with fruits, common on trees and rocks.

CAPRIFOLIACEAE

Lonicera quinquelocularis Hardw.

Bhairoghati-Vaishnodevi zone, 5700 ft.
An erect shrub, with white translucent berries.

RUBIACEAE

Wendlandia exserta DC.

Domel, 2000 ft.
An evergreen tree, abundant on steep slopes.

* **Hamiltonia suaveolens** Roxb.

Ver. Name : *Fisauni.*
Bhairoghati-Vaishnodevi zone, 5400 ft.
A shrub with blue flowers.

Galium rotundifolium Linn.

Banganga-Adhkanwari zone, 4300 ft.
A decumbent herb with fruits.

DIPSACACEAE

Dipsacus inermis Wall.
Hathimatha-Chhangichhat zone, 6150 ft.
An erect herb with pale yellow flowers.

COMPOSITAE

Conyza stricta Willd.
Banganga-Adhkanwari zone, 4100 ft.
A pubescent herb with yellowish heads.

Anaphalis triplinervis Sims ex C. B. Clarke
Hathimatha-Chhangichhat zone, 6000 ft.
An erect herb with white heads.

* **Bidens pilosa** Linn.
Domel, 1700 ft.
An erect herb with yellowish heads.

* **Artemisia vulgaris** Linn.
Ver. Name: *Tithban.*
Bhairoghati-Vaishnodevi zone, 5800 ft.
A tall aromatic herb with dirty white heads.

Artemisia roxburghiana Besser.
Hathimatha-Chhangichhat zone, 6150 ft.
An erect aromatic herb with dull purple heads.

Senecio rufinervis DC.
Bhairoghati-Vaishnodevi zone, 5300 ft.
A shrub with yellow flowers in heads.

Cnicus wallichii Hook. f.
Ver. Name: *Phoss.*
Hathimatha-Chhangichhat zone, 6050 ft.
A spinescent erect herb with dull yellow heads.

Saussurea albescens Hook. f. & Th. ex C. B. Clarke
Bhairoghati-Vaishnodevi zone, 5700 ft.
An erect herb with red heads.

* **Lactuca heyneana** DC.
Banganga-Adhkanwari zone, 4500 ft.
A tall glabrous herb with yellow heads.

OLEACEAE

* **Jasminum grandiflorum** Linn.
Ver. Name: *Chambeli.*
Banganga-Adhkanwari zone, 3100 ft.
A large climbing shrub with fruits.

* **Nyctanthes arbor-tristis** Linn.
Ver. Name : *Harsinghar.*
Ramnagar, 1000 ft.
A shrub with cream-coloured flowers.

APOCYNACEAE

Carissa opaca Stapf. *C. spinarum* Auct.
Nandini, 1900 ft.
An armed shrub with fruits.

* **Nerium indicum** Mill. *N. odorum* Soland.
Ver. Name : *Kaner.*
Nandini, 2000 ft.
An erect shrub or small tree with fruits.

ASCLEPIADACEAE

* **Pergularia daemia** (Forsk.) Chiov. *Daemia extensa* R. Br.
Ver. Name : *Dodli.*
Ramnagar, 1000 ft.
A twining herb. Common in the locality.

GENTIANACEAE

* **Gentiana kurroo** Royle
Ver. Name : *Nilakant.*
Hathimatha-Chhangichhat zone, 6000 ft.
A reclining herb with blue flowers.

BORAGINACEAE

* **Trichodesma indicum** R. Br.
Ver. Name : *Chhota kulpha.*
Nandini, 1900 ft.
An annual herb with blue flowers.

SOLANACEAE

Solanum pseudo-capsicum Linn.
Banganga-Adhkanwari zone, 4200 ft.
An erect much-branched shrub with flowers.

* **Physalis minima** Linn.
Ver. Name : *Habbikaknaj.*
Ramnagar, 1100 ft.
An erect pubescent herb with yellow flowers.

SCROPHULARIACEAE

* **Verbascum thapsus** Linn.
Ver. Name : *Gidar-tamkau.*
Banganga-Adhkanwari zone, 4200 ft.
An erect herb with yellow flowers.

Wulfenia amherstiana Benth.

Bhairoghati-Vaishnodevi zone, 5600 ft.
A glabrous herb with purplish blue flowers.

ACANTHACEAE

Strobilanthes dalhousianus C.B. Clarke

Hathimatha-Chhangichhat zone, 6150 ft.
An erect shrub with dark blue flowers.

* **Barleria cristata** Linn.

Ver. Name : *Tadrelu.*
Banganga-Adhkanwari zone, 4200 ft.
An erect undershrub, with pinkish flowers.

Lepidagathis cuspidata Nees

Banganga-Adhkanwari zone, 3500 ft.
A much-branched shrub. Common in the area.

* **Adhatoda vasica** Nees

Ver. Name: *Vasaka.*
Ramnagar, 1000 ft.
An evergreen shrub. Abundant in undergrowth.

* **Dicliptera roxburghiana** Nees

Ver. Name : *Bouna.*
Banganga-Adhkanwari zone, 3700 ft.
A diffuse herb with pink flowers.

VERBENACEAE

* **Lantana camara** Linn.

Ramnagar, 1000 ft.
A large evergreen shrub with orange flowers.

* **Vitex negundo** Linn.

Ver. Name : *Bana.*
Nagrota, 1300 ft.
A large shrub with blue purple flowers.

LABIATAE

Plectranthus coetsa Buch.-Ham. ex D. Don

Banganga-Adhkanwari zone, 4300 ft.
An aromatic shrub with lavender-blue flowers.

Plectranthus rugosus Wall.

Banganga-Adhkanwari zone, 4100 ft.
An erect shrub with white flowers.

* **Colebrookea oppositifolia** Smith

Ver. Name : *Shakkardana.*
Banganga-Adhkanwari zone, 3900 ft.
An erect tomentose shrub with fruits.

* **Origanum vulgare** Linn.
Ver. Name : *Mirzanjosha.*
Banganga-Adhkanwari zone, 4500 ft.
An erect herb with purple flowers.

Micromeria biflora Benth.
Nandini, 1700 ft.
An erect shrub with pink flowers.

* **Stachys sylvatica** Linn.
Bhairoghati-Vaishnodevi zone, 5000 ft.
An erect herb with pink flowers.

* **Leucas cephalotes** Spreng.
Ver. Name : *Gul Doda.*
Ramnagar, 1000 ft.
An erect herb with white flowers.

Teucrium quadrifarium Buch.-Ham.
Banganga-Adhkanwari zone, 4200 ft.
A stout herb with pink flowers.

NYCTAGINACEAE

* **Boerhavia diffusa** Linn.
Ver. Name : *Punarnava.*
Ramnagar, 1100 ft.
A diffusely-branched shrub with reddish flowers.

AMARANTHACEAE

* **Amaranthus spinosus** Linn.
Ver. Name : *Katailichuli.*
Ramnagar, 1000 ft.
An erect, spinescent herb with spikes.

Pupalia lappacea Juss.
Ramnagar, 1000 ft.
A large straggling undershrub with fruit.

* **Achyranthes aspera** Linn.
Ver. Name : *Kutri.*
Ramnagar, 1000 ft.
A straggling undershrub, with dull green flowers.

* **Achyranthes bidentata** Bl.
Ramnagar, 1000 ft.
A straggling undershrub, with flowers on elongated spikes.

POLYGONACEAE

* **Polygonum alatum** Buch.-Ham. ex D. Don
Bhairoghati-Vaishnodevi zone, 5600 ft.
A procumbent herb with fruits in pink heads.

Rumex hastatus D. Don
Banganga-Adhkanwari zone, 4300 ft.
A much-branched herb with fruits.

LAURACEAE

Litsaea umbrosa Nees

Bhairoghati-Vaishnodevi zone, 5400 ft.
A small-sized tree.

EUPHORBIACEAE

* **Euphorbia hypericifolia** Linn.

Ver. Name : *Hazardana.*
Ramnagar, 1000 ft.
A decumbent annual with pale pink flowers.

* **Euphorbia royleana** Boiss.

Ver. Name : *Dudal petal.*
Katra, 2700 ft.
A fleshy cactus-like tree. Abundant on hill slopes.

Sarcococca pruniformis Lindl. *S. saligna* Muell.-Arg.

Ver. Name: *Sanglu.*
Bhairoghati-Vaishnodevi zone, 5300 ft.
An evergreen shrub with male and female flowers.

Mallotus philippinensis Muell.-Arg.

Ver. Name : *Kamila.*
Banganga-Adhkanwari zone, 3300 ft.
A small evergreen tree with pale green flowers.

URTICACEAE

* **Ficus rumphii** Blume

Ver. Name : *Paker.*
Nandini, 2000 ft.
A large tree with fruits.

Boehmeria platyphylla D. Don

Banganga-Adhkanwari zone, 4400 ft.
A large shrub with fruits.

Villebrunea frutescens Blume

Nagrota, 1100 ft.
A small tree.

Debregeasia hypoleuca Wedd.

Banganga-Adhkanwari zone, 4600 ft.
A softly pubescent shrub.

CONIFERAE

* **Pinus roxburghii** Sar. *P. longifolia* Roxb.

Ver. Name : *Chir.*
Nandini onwards.
A large tree with cones, abundant on hilly slopes.

DIOSCOREACEAE

* **Dioscorea deltoidea** Wall.

Ver. Name : *Kins.*
Bhairoghati-Vaishnodevi zone, 5500 ft.
A twining herb in fruit. Common, on shrubs in moist shady places.

LILIACEAE

Smilax parviflora Wall.

Bhairoghati-Vaishnodevi zone, 5600 ft.
A climbing shrub with blue-black berries.

* **Smilax aspera** Linn.

Bhairoghati-Vaishnodevi zone, 5700 ft.
A climbing shrub with blue-black berries.

* **Asparagus adscendens** Roxb.

Ver. Name : *Sansar-pawr*.
Banganga-Adhkanwari zone, 4300 ft.
A straggling shrub with red berries.

***Gloriosa superba** Linn.

Ver. Name : *Kalihari*.
Nagrota, 1400 ft.
A straggling herb with yellow flowers changing gradually to scarlet.

COMMELINACEAE

***Commelina obliqua** Buch.-Ham. ex D. Don

Ver. Name : *Kanjuna*.
Ramnagar, 1000 ft.
An erect herb, with blue flowers.

CYPERACEAE

Eriophorum comosum Nees

Ver. Name : *Kai*.
Banganga-Adhkanwari zone, 2200 ft.
A sedge in flowers. Common on dry rocks.

GRAMINEAE

Arundinella pumila Steud.

Banganga-Adhkanwari zone, 4300 ft.
An erect grass, with spikes.

***Arundinella nepalensis** Trin.

Banganga-Adhkanwari zone, 4000 ft.
A slender, erect grass.

Pennisetum orientale Rich.

Banganga-Adhkanwari zone, 4100 ft.
A perennial grass.

Apluda mutica Linn.

Banganga-Adhkanwari zone, 4200 ft.
A leafy perennial grass.

Chrysopogon aucheri (Boiss.) Stapf.

Ramnagar, 1000 ft.
A tall grass. Frequent.

Themeda anathera (Nees ex Steud.) Hack.
Ver. Name : *Babraka.*
Banganga-Adhkanwari zone, 4200 ft.
An erect grass with fruits in spikes.

Oryzopsis aequiglumis Duthie
Bhairoghati-Vaishnodevi zone, 5600 ft.
A tall perennial grass.

Arundinaria falcata Nees
Bhairoghati-Vaishnodevi zone, 5600 ft.
A tall grass. Common in forest undergrowth.

FILICINEAE

POLYPODIACEAE

* **Adiantum caudatum** Linn.
Ver. Name : *Adhsarita-Ka-Jari.*
Nandini, 2000 ft.
A common fern of moist shady places.

Onychium japonicum Kurz
Bhairoghati-Vaishnodevi zone, 5700 ft.
A common fern, on moist shady places.

Pteris cretica Linn.
Bhairoghati-Vaishnodevi zone, 5700 ft.
A fern, frequent on moist shady places.

Polystichum aculeatum Sw.
Bhairoghati-Vaishnodevi zone, 5700 ft.
A fern, abundant on moist shady places.

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The Birds of the Maldive Islands, Indian Ocean

BY

W. W. A. PHILLIPS

(*With two maps and three plates*)

INTRODUCTION

Until a few years ago almost the only information available in connection with the ornithology of the Maldivian Archipelago was contained in the rather brief notes of Gadow & Gardiner (1903) where 24 species of birds were listed, some of them rather doubtfully, as occurring in the Maldives. Then, during the three months of December 1956 to February 1957, the author visited the capital, Malé, situated in North Malé Atoll and lying slightly to the north of the centre of the archipelago; as a result, an additional 39 species were added to the list of Maldivian birds (Phillips & Sims, 1958b). Furthermore, specimens of three endemic races, two of them new to science, were collected.

Subsequently, many of the atolls were visited by the Xarifa Expedition of the International Institute for Submarine Research, under the direction of Dr. Hans Haas. During this expedition, Drs. Georg Scheer and L. Franzisket devoted some of their time to collecting and observing the bird life of the atolls. Then, from May 1958 until April 1959, the author resided in Gan Island, Addu Atoll, in the extreme south. During his second stay in the Maldives, all the chief islands and reefs of Addu Atoll were visited frequently, and several brief excursions were made to Suadiva Atoll as well as a short return visit to Malé. And lastly, while this paper was being written and revised, additional notes were received from J. J. Latham (W/O., R.A.F.) who served in Addu Atoll in 1960 and 1961.

The results of the observations made on my last visit, together with those of Dr. Scheer and Mr. Latham, form the basis of this paper. Furthermore, in order to give as complete a picture as possible of the bird life of the atolls, breeding and migrations are briefly described in addition to incorporating all available information into the Systematic List.

The 1956/57 visit increased the number of species, recorded from the Maldives, from 24 to 63; the present paper now advances the number of forms to 113 of which 73 are supported by collected specimens and the remaining 40 by sight records only. Forms peculiar to the Maldives are increased to 5 endemic races, including one of *Ardeola grayii* described by Dr. George Scheer (1960).

GEOGRAPHY AND ECOLOGY

The Maldivian Archipelago, consisting of upwards of 2500 small coral islands, islets, and exposed reefs, of which less than 250 are permanently inhabited, lies in the Indian Ocean over 400 miles to the west and south-west of Ceylon. It is located between 8° N. and 1° S. and between 72° to 74° E. In length, the archipelago stretches for over 470 miles, from the Eight Degrees Channel, south of the Laccadives and Minicoy (or Minikai) Island (at one period of its political history forming a part of the Maldives) to Addu Atoll, some 30 miles south of the Equator and 300 miles north of the Chagos Islands.

With the exception of a small number of isolated islets, the islands and their encircling reefs form 19 natural groups, clusters or 'atolls', of varying sizes and shapes, which in their turn form an incomplete, double chain, nowhere wider than 70 miles, running practically north and south. It would seem probable that the atolls have gradually been built up around and along the crests of a submerged, interrupted mountain range or ranges for, while within the central lagoons enclosed by the more or less circular peripheral reefs the depth of the water averages no more than 25 fathoms, it may reach 2000 fathoms in the seas close outside the islands.

In all the nineteen atolls the formation is very similar—an interrupted, peripheral reef, on the higher sections of which long, low, flat islands have been formed, encloses a wide shallow lagoon generally dotted with a varying number of small islets and coral sand-banks together with numerous flat-topped, tidal reefs. As a rule, tides of between three and four feet are normal throughout the archipelago, the reefs, dangerous in the extreme, being mostly exposed or awash during low water. Between the atolls, deep (frequently dangerous) channels of varying width and depth, in which ten-knot currents race when the monsoon winds are blowing, divide and isolate one atoll from the next.

Climatic conditions are closely similar throughout the atolls but the northerly islands are more subject to the impacts of the North-east Monsoon from November to January, and of the South-west Monsoon from April to July, and are, in consequence, perceptibly cooler at times. In the southern atolls of Suadiva and Addu, which lie close to the Equator and within the doldrums, the impact of the monsoons is very slight and the climate is more humid.

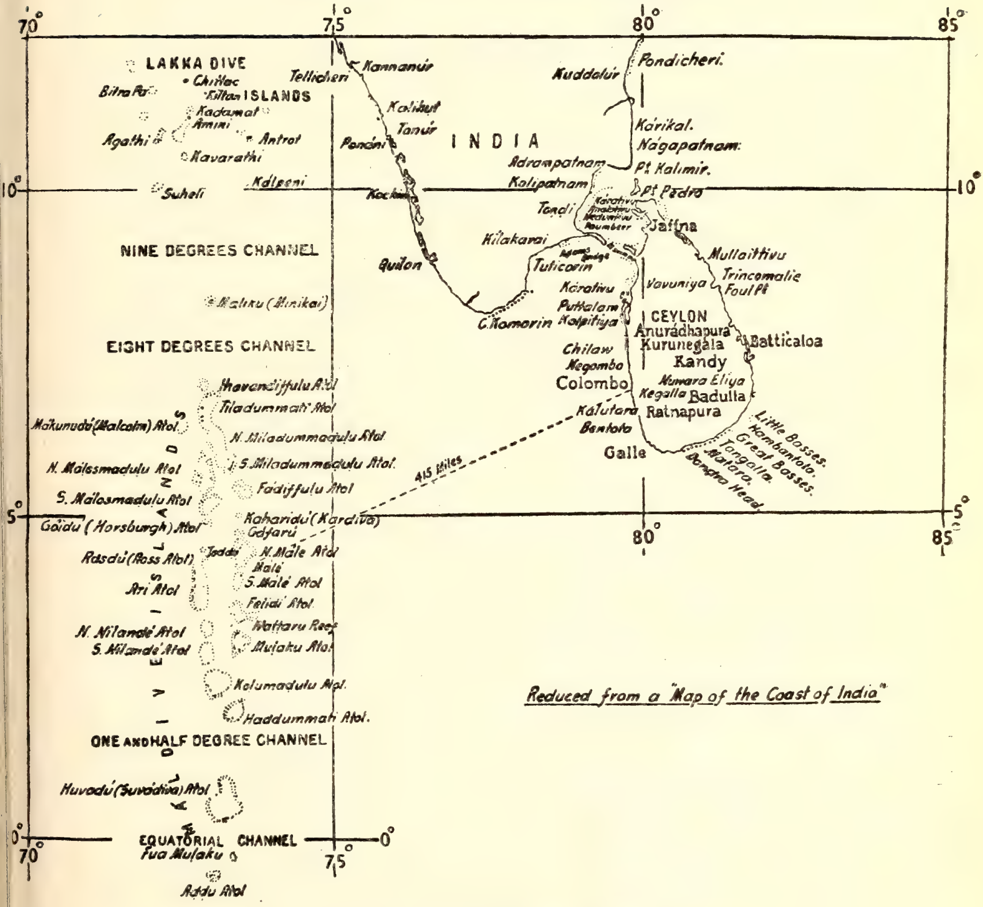
Rainfall averages, annually, between 90 and 100 inches; it is often associated, especially in the southern atolls, with sudden, severe tropical storms. Generally, however, the fall is well distributed; long droughts are rare but deluges of several inches are not infrequent. Humidity is high, especially in the southern atolls, close to the Equator. Day temperatures vary between 80° and 95° in the shade, which in conjunction with the high humidity makes the climate very trying for the average European.

None of the islands rises more than five feet above mean sea-level and many of them have marshy interiors and freshwater ponds; the water-table is rarely more than four or five feet below ground-level. Originally, the islands were composed entirely of coral sand but, in course of time through the rotting of vegetable matter and the formation of humus, they have become well clothed with luxuriant vegetation, both high and low.

Geologically, the archipelago is of comparatively recent formation; so recent, in fact, that distinct forms of animal or plant life are only just beginning to emerge. The terrestrial mammalian and reptilian fauna is very limited and is confined to a few species (Phillips, 1958; Hill, 1958) common to the Indian peninsula and/or Ceylon, except for one fruit-bat, *Pteropus hypomelanus maris* Allen, which was described from Addu Atoll but which I was unable to trace in that Atoll. Of the other mammals, only the Common Flying-fox has diverged sufficiently to be accepted as a distinct endemic form, *Pteropus giganteus ariel* Allen. None of the reptiles is distinct but, amongst the birds, five local races are considered worthy of recognition.

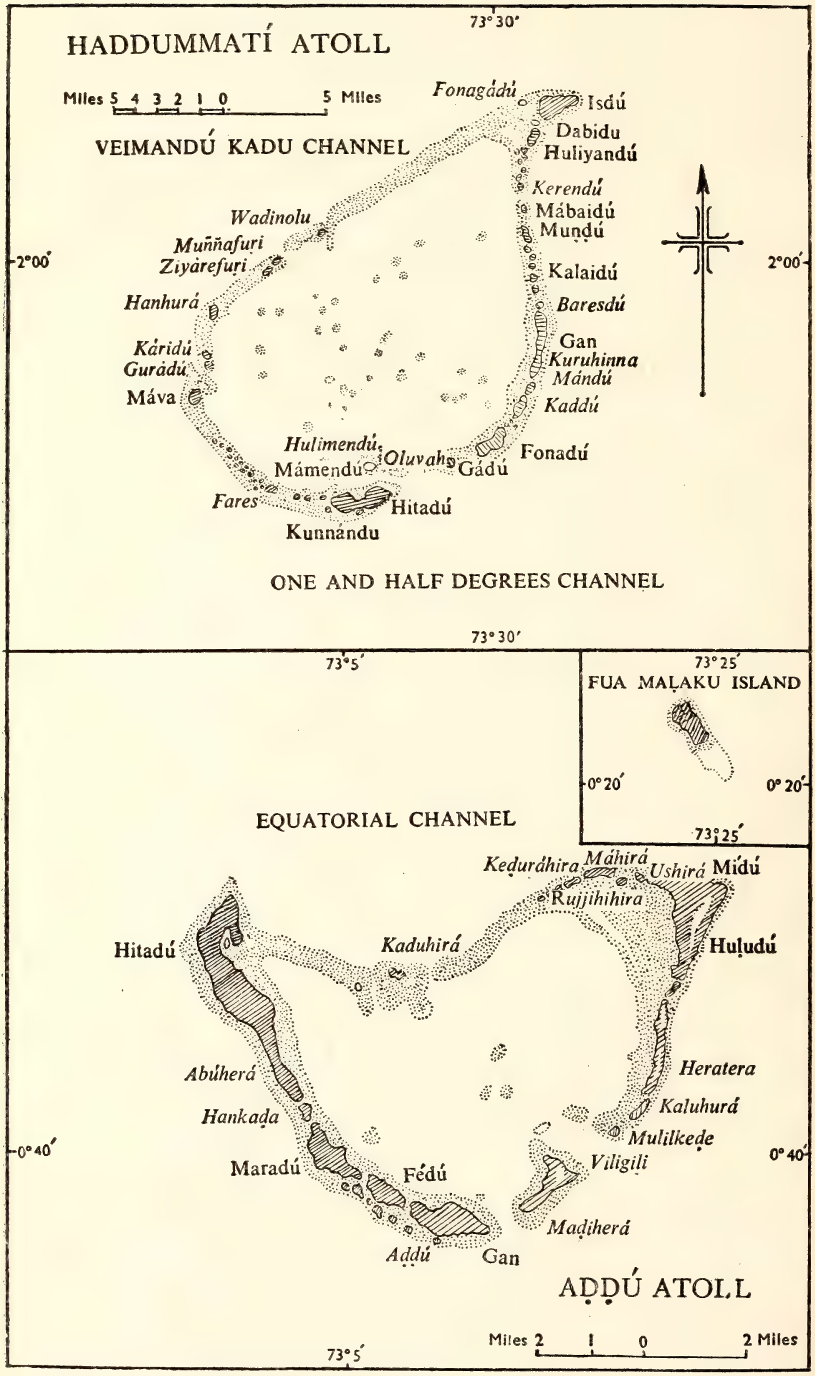
It would appear that the archipelago has been colonized by animal and plant life almost entirely from the Indian mainland and Ceylon, either by 'island hopping' down through the Laccadives or by direct drift aided by the north-easterly monsoon winds as well as, in some cases such as the small rodents and shrews, by the unintentional assistance of man and his ships. But the fact that the Double Coconut or Coco de Mer, *Lodoicea seychellarum*, has occasionally been washed ashore on the western littoral, having drifted from the Seychelles over

MAP OF SOUTHERN INDIA AND CEYLON
WITH THE
LAKKADIVE AND MÁLDIVE ISLANDS


70°
75°
80°
85°
10°
5°
0°
LAKKA DIVE ISLANDS
Bitra Pa
Chitlac
Kiltan
Kadamat
Amini
Agathi
Antrot
Kavarathi
Kalpeni
Suheli
Tellicheri
Kannanúr
Kalikut
Tanúr
Ponáni
Kochin
Quilon
INDIA
Kuddalúr
Pondicheri.
Kárikal.
Nágapatnam.
Adrampatnam
Pt. Kalimir.
Kalipatnam
Pt Pedro
Tondi
Kilakarai
Jaffna
Tuticorin
Mullaittivu
Trincomalie
Foul Pt
Vavuniya
Karativu
Puttalam
Kalpitiya
C. Komorin
CEYLON
Anurádhapura
Kurunegála
Batticaloa
Kandy
Chilaw
Negombo
Colombo
Nuwara Eliya
Kegalla
Badulla
Kálutara
Ratnapura
Bentota
Galle
Little Basses.
Hambantota.
Great Basses.
Tangalla.
Matara.
Dondra Head.
415 Miles
NINE DEGREES CHANNEL
Maliku (Minikai)
EIGHT DEGREES CHANNEL
MALDIVE ISLANDS
Ihavandiffulu Atol
Tiladummati Atol
Málkunudú (Malcolm) Atol
N. Miladummadulu Atol
S. Miladummadulu Atol
N. Málosmadulu Atol
Fadiffulu Atol
S. Málosmadulu Atol
Kaharidu (Kardiva)
Góidu (Horsburgh) Atol
Gáfaru
Rasdú (Ross Atol)
Toddu
N. Málé Atol
Málé
S. Málé Atol
Ari Atol
Feliái Atol
Wattaru Reef
N. Nilandé Atol
S. Nilandé Atol
Mulaku Atol
Kolumadulu Atol.
Haddummati Atol.
ONE AND HALF DEGREE CHANNEL
Huvadú (Suvádiva) Atol
EQUATORIAL CHANNEL
Fua Mulaku
Addu Atol

Reduced from a "Map of the Coast of India"

(From H. C. P. Bell's MONOGRAPH)


HADDUMMATÍ ATOLL
73°30′
Miles 5 4 3 2 1 0 5 Miles
VEIMANDÚ KADU CHANNEL
Fonagádú
Isdú
Dabidu
Huliyandú
Kerendú
Mábaidú
Mundú
Kalaidú
Baresdú
Gan
Kuruhinna
Mándú
Kaddú
Fonadú
Gádú
Wadinolu
Muññafuri
Ziyárefuri
Hanhurá
Káridú
Guradú
Máva
Hulimendú
Mámendú
Oluvah
Fares
Hitadú
Kunnándu
2°00′
2°00′
ONE AND HALF DEGREES CHANNEL
73°30′
73°5′
73°25′
FUA MALAKU ISLAND
0°20′
0°20′
73°25′
EQUATORIAL CHANNEL
Kedurâhira
Máhirá
Ushirá
Midú
Rujjihihira
Kaduhirá
Hitadú
Huludú
Heratera
Kaluhurá
Mulilkede
Viligili
Abúherá
Hankada
Maradú
Fédú
Madiherá
Addú
Gan
0°40′
0°40′
ADDÚ ATOLL
Miles 2 1 0 2 Miles
73°5′

1700 miles to the south-west, shows that there are possibilities of some colonization from the west or African zone.

As a direct result of the abundant and well-distributed rainfall, all the islands with the exception of those of very recent emergence have a luxuriant but specifically rather limited vegetation in those areas that have remained untouched by the hand of man. In the interiors of many of the larger islands, shallow brackish or freshwater pools and marshy areas occur, verged with extensive reed-beds, rank grass tracts, and matted pandanus brakes, the home of *Amaurornis phoenicurus* (the Swamp-Hen or Whitebreasted Waterhen), herons, and other marsh-loving birds, and the haunt of numerous migrant water-fowl and waders during the northern winter months. The natural vegetation clothing the remainder of the land, right down to the beaches, consists of large trees with dense, often matted, undergrowth through which it is difficult to force a passage. Most of the larger islands have however been cleared and planted with coconut palms, without which life for the Maldivians would be barely supportable. Villages and townships have been built on some of the islands, the surroundings of the houses being planted with many, large-leafed breadfruit trees, *Artocarpus incisus*, partly to give ever-welcome shade to the dwellings but chiefly to provide additional vegetable food. A few mango trees, *Mangifera indica*, areca-nut palms, *A. catechu*, drumstick trees, *Moringa* sp., tamarind, *Tamarindus indicus*, and edible pandanus are generally dotted about within the gardens or compounds, with several varieties of bananas, a few pomegranates, and large or small areas of yams as garden produce. In the open meeting places bo trees *Ficus religiosa* and banyans *F. bengalensis* are frequent. The Maldivian House Crow, *Corvus splendens maledivicus*, and an occasional Koel, *Eudynamys s. scolopacea*, are normally the only birds to be seen, except on the beaches when the tide is low.

Since under Muslim teaching only web-footed wild-birds may be used for food, Boobies, Frigate-birds, Shearwaters, Ducks, and Terns are taken as and when opportunities offer; frequently they are brought to the markets, alive but wing-clipped, for sale as food. Most of them are taken while they are nesting or roosting, for the Maldivians are adept at snaring. Other species are also taken and kept alive, with one wing clipped, as pets or playthings for the children who are without dolls or toys such as are enjoyed by those of more advanced lands. So, in the more densely populated atolls, the bird life often suffers considerably from the depredations of man, even if other enemies are few.

BREEDING SEASONS

On landing in the Maldive Islands, the ornithologist is immediately impressed by the total absence of small passerine birds. No singing or cheerful chirping greets him, either in the jungles or around the dwellings—only the occasional harsh 'caw' of the House-crow, the sole resident passerine in the whole of the archipelago, welcomes him.

Of the 113 species and subspecies of birds that are now accepted as occurring in the Maldives, under 20 species are known to be truly resident in the atolls. Several more, such as the Brown Booby, *Sula leucogaster,* Crab-plover, *Dromas ardeola,* Pratincole, *Glareola pratincola,* and some of the numerous terns are suspected of breeding in the more remote atolls but further research is required before their true status can be determined. Furthermore, observations on the breeding of the resident species are still too inadequate for definite conclusions to be formed regarding their breeding seasons but it would appear most probable that most species breed, with varying intensity, throughout the greater part of the year—as might be expected in a climate where there is so little variation in the seasons, length of daylight, temperature and rainfall.

A brief summary of our present knowledge of the breeding of each of the resident species is as follows:

Audubon's Shearwater, *Procellaria lherminieri bailloni,* lays its eggs in burrows dug in the coral sand on a number of secluded islands scattered along the eastern aspect of the archipelago, from Suadiva Atoll in the south (the bird does not breed in Addu) to Fádiffolu Atoll in the north. Gardiner recorded 'great numbers' breeding on Difuri and Olivelifuri islands, in Fádiffolu Atoll and the collecting of both eggs and chicks at the end of December. I recorded fresh eggs and chicks at the end of January (1957) and the local Maldivians, who use both the eggs and the birds as food, state that breeding continues throughout the year. This requires confirmation. Owing to the depredations of the fisherfolk, this shearwater appears to be rapidly decreasing in numbers in the Maldivian area.

The beautiful Long-tailed Tropic-bird, *Phaëthon l. lepturus,* a moderately plentiful species that frequents the lagoons and sparsely populated islands in all atolls, nests in cavities in old evergreen trees, such as *Hernandia ovigera* and *Cordia subcordata.* Gardiner records both eggs and young on 24 November and young, still unable to fly, were brought to Malé in January. In Suadiva Atoll, breeding was suspected in late March but not proved and in Addu in early July. In both cases, the local Maldivians stated that breeding was in progress. During the heat of the day in hot, sunny weather, these birds very frequently seek shade and rest in large shady trees; often several will circle round and round, calling continually for half an hour or more before making a successful landing, their feet not being developed for perching in trees.

The Lesser Frigate Bird, *Fregata ariel iredalei*, was discovered by Gardiner nesting in the tops of tall trees, *Calophyllum inophyllum* and *Terminalia catappa*, in Mahlosmadulu Atoll during October and November. Although I received rumours of breeding in other atolls, this appears to be the only authentic record available. The Eastern race of the Common Heron, *Ardea cinerea rectirostris*, a common bird throughout the archipelago, nests in the tops of coconut palms, in wild pandanus trees in swampy areas, and in small trees and large bushes overhanging lagoon shores. Gardiner records young during July and August; in Malé, two semi-fledged young were brought to me in early December and nests and young were seen in January. In Addu Atoll, I saw occupied nests early in June and the same nests were reoccupied early in December while young were in the nests during January and February. Indications are, therefore, that this heron breeds at least twice during the year, generally from June to August and from December to February. Possibly breeding may be intermittent throughout the year.

The Little Heron, *Butorides striatus*, commonly nests in bushy trees growing close to lagoons or in swamps, as well as in the tops of pandanus trees. I have observed nesting in North Malé Atoll (*B. s. didii*) during December and January and in Addu Atoll (*B. s. albidulus*) I found eggs and small young in mid-October and again towards the end of January but birds in full breeding plumage, with reddish pink legs, were noted in almost every month. It would seem probable, therefore, that although the majority breed during the period October to February, some breed at other times of the year.

The Maldivian Pond-heron, *Ardeola grayii phillipsi*, is even more plentiful in Addu Atoll than the Little Heron, *B. s. albidulus*, but nests are difficult to find. Individuals in full breeding plumage, with reddish pink legs, have been noted throughout the year; a large chick, taken from a nest, was examined on the 18 October; a pair was observed building a nest in the top of a wild pandanus on the 24 January when almost all of these birds appeared to be in breeding dress and on the 14 February a female containing 3 oviduct eggs, almost due to be laid, was collected. It seems from this evidence that this bird also breeds chiefly during the period September or October to March or April as well as, less intensively, at other times of the year.

The Swamp-Hen or Whitebreasted Waterhen, *Amaurornis phoenicurus*, although plentiful in all the atolls is so elusive and its nests are so well concealed that it is difficult to study its breeding. Nests are concealed amongst rank vegetation and in low bushes. Gardiner recorded a young bird (*maldivus*) taken from a nest in July; in Addu Atoll birds (*phoenicurus*) were very noisy and apparently commencing to breed in June and a ¾ grown juvenile was seen on the 21 July and three well-grown chicks on the 25 August. Again, in October a ½ grown chick was observed on the 10th and a hatchling on the 18th. From these observations it would seem that this bird breeds from about June to November or, possibly, throughout the year.

Although at least 10 species of terns are stated by the Maldivians to breed in the archipelago, we have authentic records of the breeding of only four. The Blacknaped Tern, *Sterna sumatrana mathewsi*, was said by the local Maldivians to nest in North Malé Atoll in April and May but it was not until early June that I located several breeding colonies on sandy islets in Addu Atoll. Breeding appears to be confined to the months of May, June, and July.

The Common Noddy, *Anoüs stolidus pileatus*, is exceedingly numerous, at times, in many of the atolls but although its presence within the lagoons (as well as in the seas outside) is well known to the Maldivians, they know nothing of its breeding. However, on the 28 April, I discovered a single nest, containing a newly hatched chick, on a large metal marker-buoy anchored in Addu Atoll lagoon. This appears to be the sole definite record of the breeding of this noddy in the Maldives. Gardiner states that Forster Cooper took an adult female and a nestling of the Lesser Noddy, *A. tenuirostris*, from a nest in a pandanus (Screw-pine) on Mabaru Island, South Mahlosmadulu Atoll, on 26 November 1899; he states further the Lesser Noddy is 'nowhere common, but found throughout the whole of the Maldives' but he fails to mention the presence of the Common Noddy. A search in both North Malé and in Addu Atoll failed to yield a single Lesser Noddy but showed that the Common Noddy is plentiful. It seems possible, if not probable, therefore, that this nesting record should, in fact, refer to the Common Noddy. In any case, it is interesting that one of the records should refer to a Noddy nesting in November and the other to one nesting in April, indicating that either the two species (if two species do, in fact, occur in the Maldives) breed at different times during the year or, alternatively, that the Common Noddy (if both the records refer to that species) breeds either in the spring or in the autumn or during both these periods.

The charming White Tern, *Gygis alba monte,* breeds very freely in Addu Atoll, to which atoll it is confined. Probably owing to the presence of large numbers of House-crows, *Corvus splendens maledivicus,* it has not been able to establish itself in other atolls. Presumably, also, it is of comparatively recent arrival in Addu Atoll as it is not mentioned by Gardiner; he could hardly have overlooked it, had it been present at the time of his visit. In Addu Atoll, it is always present in the trees around the villages, flying overhead or sweeping over the central lagoon and near-by seas. In habits, it is essentially a 'tree-tern'. Moreover, though it is often active throughout the greater part of the day, it prefers the early mornings and late evenings for its foraging and is often on the move on moonlight nights. Generally, when incubating its single egg on a horizontal branch, high stump, or other lodgement in a tree or palm, it is most confiding in its behaviour towards man but it will collect in large numbers to mob to exhaustion or precipitous flight any crow, buzzard, or other potentially dangerous bird that appears in the vicinity. It is probable that pairs mate for considerable periods. Frequently a pair indulges in dual display flights over the lagoon and the land. Although only a single egg is laid at each laying, observations point to each pair raising, or attempting to raise, several young during each year. Breeding continues throughout the year but my notes show that the peak periods are during January and early February and again towards the end of May and in June.

The single resident Cuckoo, the Koel, *Eudynamys s. scolopacea,* is dependent upon the Maldivian House-crow, *Corvus splendens maledivicus* as host, so its breeding must coincide with that of the crow. An oviduct egg was taken in Malé on 11 December and a juvenile, scarcely able to flutter, was captured on another island in North Malé Atoll on 23 January when the crows were nesting. The koels of Addu Atoll are most puzzling as, although both sexes are present and courtship flights were observed, there are no crows or other suitable foster-parents present in the atoll; presumably, therefore, the koels of Addu Atoll are either of non-breeding stock or they return over 30 miles of ocean to Suadiva Atoll in order to breed.

Although Gadow & Gardiner state that the Maldivian House-crow breeds between May and September, I saw no signs of breeding in the southern atolls either at the end of May, when all crows appeared to be in moult, or in July. On the other hand, I saw nest-building in

North Malé Atoll early in December and again in January when all crows were in full plumage. It would seem probable, therefore, in spite of Gadow & Gardiner's statement, that the breeding period extends from about November to March or April if it does not continue, intermittently, throughout the greater part of the year.

TABLE SHOWING OBSERVED AND PRESUMED BREEDING OF MALDIVIAN RESIDENT BIRDS

(Unconfirmed breeding is denoted by 'P' and confirmed by 'B')

	June	July	August	September	October	November	December	January	February	March	April	May
Procellaria lherminieri bailloni	P	P	P	P	P	P	B B	B B	P	P	P	P
Phaëthon lepturus lepturus		P				B	B B	B B	P	P		
Fregata ariel iredalei					B B	B B						
Ardea cinerea rectirostris	B B	B B	B B				B B	B B	B B			
Butorides												
striatus didii							B B	B B				
striatus albidulus					B B	B P	P P	B B	B B			
Ardeola grayii phillipsi				P	B B	P P	P P	B B	B B			
Amaurornis phoenicurus	P B	B B	B B	P P	B B	P						
Sterna sumatrana mathewsi	B B	B B									P	P B
Anoüs												
stolidus pileatus											B	B B
tenuirostris ?					P B	B P						
Gygis alba monte	B B	B	B	B	B	B	B	B B	B B	B B	B	B B
Eudynamys scolopacea scolopacea						B B	B B					
Corvus splendens maledivicus	?	?	?	?		P	B B	B B	B			?

Migration

Some slight knowledge of the migratory movements in the Maldives was gained during my first visit to Malé, in North Malé Atoll, from the end of November 1956 to the beginning of February 1957. This knowledge was added to, considerably, during my subsequent residence in Addu Atoll during 1958 and early 1959 and has been further extended by the notes collected by Mr. J. J. Latham during his service on Gan (Addu) in 1961 and 1962.

The observations made in Addu Atoll confirm that considerable numbers of non-breeding visitors, of eastern European and western Asian origin, arrive from the north during October to December (a few may come in August and September) and return northwards during the following March to May; it has also been established that unexpectedly large numbers of non-breeding waders loiter in the southern Maldives throughout the northern summer months. Furthermore, evidence has been collected that tends to show that some migrants travel beyond Addu Atoll to the Chagos Archipelago, over 300 miles to the south, and return later.

Since it was stressed in 1958 (Phillips & Sims) that so very little information had been recorded from the Chagos Islands, Loustau-Lalanne has published his paper (1962) on the birds of that archipelago. In this paper, he lists, as 'migrants recorded November/December 1960', the following: *Anas* sp. seen in flocks on Diego Garcia; *Charadrius squatarola,* several of which were seen in December; *Numenius phaeopus,* often seen feeding under the coconuts in December; *Numenius arquata,* one shot on the beach in December; *Arenaria interpres,* seen in flocks on the beach on several islands; *Crocethia alba,* two of which were seen on the outer beach of Diego Garcia; *Dromas ardeola,* which is probably an itinerant resident in both the Chagos and the Maldivian archipelagos and several hirundines which, he states, were probably *Delichon urbica.* He states, further, that reports received locally show that the hirundines arrive in the Chagos Islands in November and leave again in March.

It is significant that all the migrant species mentioned were recorded in Gan (Addu) between October and March or April, in 1958/59 and again in 1961/62, indicating that they are regular annual winter visitors. On several occasions it seemed most probable that the birds seen had arrived in Gan (Addu) from the southward, instead of from the north; there are therefore strong indications, supported by Loustau-Lalanne's paper, that small numbers of migrants pass through the Maldives into the Chagos Archipelago where they spend the whole or part of the winter before returning by the same route. Only ringing or 'banding' can confirm or disprove this theory.

The following notes briefly outline the movements of some of the more notable species that visit the Maldivian atolls but do not qualify as residents.

PROCELLARIDAE. The three regular visiting species of this family: Wilson's Petrel, *Oceanites oceanicus,* the Wedgetailed Shearwater, *Procellaria pacifica,* and the Pinkfooted Shearwater, *P. carneipes,* all appear to conform to the accepted movement pattern of southern-hemisphere-breeding species that visit the northern waters of the Indian Ocean during the southern winter. All three species are reported to arrive in the waters off the Maldives towards the end of March and in April and to leave during the following October and early November. The single Bulwer's Petrel, *Bulweria bulwerii,* taken in Addu Atoll on the 22 August, was the first of its species to be reported in the Indian Ocean.

ARDEIDAE. A Purple Heron, *Ardea purpurea,* appeared in Addu Atoll on 13 October (1958) but, being a juvenile, the race to which it is referable cannot be determined; another was observed, in Gan (Addu), by J. J. Latham on 14 July (1961). These may have come from the north, moving from atoll to atoll down the length of the Laccadives and the Maldives, but it is possible that they might have crossed over from the Chagos Islands. The early dates of arrival would seem to point to the latter. The Eastern Large Egret, *Egretta alba modesta,* did not arrive in Addu Atoll until 20 December, indicating that it had gradually worked its way southwards through the atolls; it is well known to the Maldivians as an annual visitor.

A party of Black Bitterns, *Dupetor f. flavicollis,* was observed flying south-west across Gan Island, Addu Atoll, on 4 June; no other was seen in this atoll, so this party may have gone farther south. Farther north, it is an annual visitor, in small numbers, during the northern winter. Both the Chestnut Bittern, *Ixobrychus cinnamomeus,* and the Little Yellow Bittern, *I. sinensis,* appear to be vagrants.

ANATIDAE. Wild ducks commenced to arrive in Addu Atoll with a flight of Garganey, *Anas querquedula,* on 3 October. Flights of up to 25 were frequent until the middle of January. In early November, small parties of Shovellers, *Spatula clypeata,* and a few Pintail, *Anas acuta,* were seen. These three species seem to be regular visitors from the north but the White-eyed Pochard or

Ferruginous Duck, *Aythya nyroca,* and the Cotton Teal, *Nettapus c. coromandelianus,* that appeared in Gan, Addu Atoll, early in December were probably vagrants. The Garganey is well known to the Maldivians of Addu Atoll but I heard nothing of it farther north; it is likely that the flocks of '*Anas* sp.', recorded in the Chagos Islands, were of this species.

FALCONIDAE. All members of this group are either migrants or vagrants; none is resident. The Honey-buzzard, *Pernis apivorus orientalis,* arrived in Addu Atoll on 4 December, the Buzzard, *Buteo* sp., on 14 January, and the Osprey, *Pandion haliætus,* in July; all were probably stragglers from the north, working their way southward. The Harriers, which are regular visitors to the whole of the Maldives during the northern winter months, commenced to arrive in Addu Atoll about the middle of November; they remained, feeding chiefly upon *Calotes* lizards, *C. versicolor,* and large grasshoppers, until the middle of the following March. These Harriers, *Circus macrourus* and *C. pygargus,* are well known to the Maldivians who dislike them as they take an occasional chicken. The Common Kestrel, *Falco t. tinnunculus,* is also a regular migrant to the northern atolls but it is uncommon in Addu Atoll where its place is taken by the Lesser Kestrel, *F. n. naumanni,* and the Eastern Redlegged Falcon, *F. vespertinus amurensis.* The former arrived in a small party on 12 November and the latter on 5 December. Neither of these two species has been recorded from any other atoll—like the Harriers, they probably came from the north. A single Peregrine, *F. peregrinus,* arrived in Addu Atoll in the middle of October (14th); it appeared to depart in a southerly direction and, as it was not seen in Addu again, may have passed on to the Chagos Islands.

CHARADRIIDAE. With the exception of the Caspian Plovers, *Charadrius asiaticus,* which were probably stragglers to Addu Atoll, all the representatives of this family appear to be regular annual visitors, in small or large numbers, during the northern winter period. The Lesser Sand Plovers, *C. mongolus atrifrons,* were the first to arrive in Addu Atoll; they were closely followed by the Grey Plover, *C. squatarolus,* both species commencing to fly in during the latter half of August. The Large Sand Plover, *C. leschenaultii,* came in September and the Asiatic Golden Plover, *C. dominicus fulvus,* in flocks, in early October. But it was not until the second week in November that large influxes of plovers took place. Then, in addition to the foregoing, the Ringed Plover, *C. hiaticula tundrae,* arrived on the 17th, Jerdon's Little Ringed Plover, *C. dubius jerdoni,* on the 10th (with the two Caspian Plovers) and the Kentish Plovers, *C. alexandrinus*, on the 18th. From the middle of November to April there were always considerable numbers of plovers, of various species, to be seen in Addu Atoll where they spent the winter. A small flock of non-breeding Grey Plovers and at least two Large Sand Plovers remained the whole year on and around Gan Island.

The Turnstone, *Arenaria i. interpres*, the most abundant of all the waders that visit the Maldives, appeared in Addu Atoll at the end of May when a flock of 25 arrived; probably they were non-breeding loiterers but towards the end of June another flock of *c.* 65 appeared. Did they come from the north or did they come in from the Chagos Islands, to the south? That considerable numbers of non-breeding birds loiter in the Maldives throughout the northern summer period is certain but it is curious that large flocks should arrive in Addu Atoll in May and June.

SCOLOPACIDAE. Three species of snipe visit Addu Atoll although only one species, the Pintail Snipe, *Capella stenura*, was seen in North Malé Atoll. Swinhoe's Snipe, *C. megala*, of which a single specimen was collected on 8 November, is almost certainly a rare straggler but the Pintail Snipe and the Fantail or Common Snipe, *C. g. gallinago*, are both regular annual visitors to Addu. *C. stenura* arrived on 4 October, after which date there were always small numbers in the marshy areas until the following spring. *C. gallinago*, however, did not arrive until 15 December, after which date a few wisps were generally present. Although *C. gallinago* did not arrive until so long after the arrival of *C. stenura*, it was the former species only that Gardiner found so plentiful in Addu Atoll, in April 1900, that he thought the species must breed there.

While the Eastern Curlew, *Numenius arquata orientalis*, which did not arrive in Addu Atoll until 6 November, is a scarce visitor, the Whimbrel, *N. p. phaeopus*, is one of the most abundant of all the birds that visit the Maldives. Not only do large numbers spend the northern winter in the archipelago but many non-breeding birds remain in Addu throughout the summer as well. Some of these loiterers appear to pair and behave as though they were about to breed but none actually did. The numbers in the atoll have been observed to fluctuate from time to time so some may pass to the Chagos Islands and return or, alternatively, they may fly northwards and return. Birds intending to breed have generally left Addu by late March or early April.

A single, non-breeding Bartailed Godwit, *Limosa lapponica*, also spent a year in Addu Atoll; presumably, it was a straggler from the north.

In 1958, the Wood Sandpiper, *Tringa glareola*, and the Common Sandpiper, *T. hypoleucos*, arrived in Addu Atoll on 12 and 10 August, respectively. These arrival dates coincide with the early arrival dates of these two species in the south of Ceylon (Phillips, 1957) and are probably normal. Both are regular visitors but whereas *T. hypoleucos* comes in considerable numbers *T. glareola* is distinctly scarce. The Eastern Redshank, *T. totanus eurhinus*, and the Greenshank, *T. nebularia*, both regular visitors, did not appear until November, the Greenshank arriving in small parties early in the month and the Redshank later. Terek Sandpiper, *Xenus cinerea*, came in about the same time (21 November); this curious little wader may be an annual visitor, in small numbers, as it is in Ceylon.

The majority of waders of the genus *Calidris* also commenced to arrive about the middle of November; the Little Stint, *C. minuta*, a regular visitor in small numbers, arrived on 11 November, the Longtoed Stint, *C. subminuta*, on the 17th and the Dunlin, *C. a. alpina*, on 25th. The occurrence of small parties of *C. subminuta* in Addu Atoll was as interesting as unexpected; hitherto the species had not been recorded from so far westwards. They remained until late February. The arrival of *C. a. alpina* was also unexpected as, although the species occurs in northern India, it has not yet been recorded from Ceylon. A single Temminck's Stint, *C. temminckii*, was seen in Addu on 5 October; another, possibly a non-breeding loiterer, was there on 26 May.

The Curlew Sandpiper, *C. testacea*, is puzzling. On 23 May a party of 8 appeared on Gan, Addu Atoll, and next day there were two parties of 5 and 7 respectively; all but one were in non-breeding plumage. On 25 June, a flock of between 45 and 50 appeared while on 16 October a large company, estimated at over 100, passed over flying westwards. Obviously, many non-breeding birds loiter in the southern Maldives during the northern summer months but from where did the parties suddenly appear in May and June? It seems reasonable to suspect that some of them may have come up from the Chagos Islands.

A single Sanderling, *Crocethia alba*, appeared on the southern beach of Gan, Addu Atoll, on 15 November and a juvenile Ruff, *Philomachus pugnax*, on 5 October; both unusual visitors from the north.

LARIDAE. At present there is insufficient information available to permit of the classification, as residents or visitors, of many of the

Maldivian terns. It is evident, however, that the single Whitewinged Black Tern, *Chlidonias leucoptera,* collected in Addu Atoll on 8 November, was a northern visitor and so were the two Tibetan Terns, *Sterna hirundo tibetana,* taken on 11 January and 22 February, respectively. A single Mesopotamian Ternlet, *Sterna albifrons praetermissa,* caught on 15 November, was also a northern visitor but the race *S. a. saundersi,* which is so plentiful in the Maldives, and several of the other species of terns are presumably residents. It is curious that the Brownheaded Gull, *Larus brunnicephalus,* which is so plentiful in India and Ceylon during the northern winter, does not visit the Maldives.

CUCULIDAE. Cuckoos are notorious wanderers so it is interesting to record that in 1959 two species arrived in Addu Atoll within a week of one another; the Common Cuckoo, *Cuculus canorus,* on 4 January and the Plaintive Cuckoo, *Cacomantis merulinus passerinus,* on 13 January. Another Common Cuckoo was seen during the first week of January 1961. Both these species are known as habitual wanderers.

APODIDAE. The occurrence of three species of swifts is of more than passing interest. An Edible-nest Swiftlet, *Collocalia brevirostris,* was seen in Malé, North Malé Atoll, on 19 December 1956 and another in 1957, while still others were observed in Gan in 1961/62 yet there are no normal roosting places available in the Maldives; so, contrary to their usual habits, these swifts must have roosted either in trees or in low buildings. It seems odd that they should have wandered into the Maldives. A common Swift, *Apus apus,* was observed flying southward over Gan, Addu Atoll, on the morning of 1 November; it disappeared in the general direction of the Chagos Archipelago. It appeared to be on passage and was not feeding, as it passed over.

MEROPIDAE. On 10 January, a party of one adult and two first-year Common Bee-eaters, *Merops apiaster,* appeared on Gan, Addu Atoll; they remained until 31 March, living chiefly on large dragonflies. Their presence in Addu Atoll was most unexpected; presumably they came from the north.

HIRUNDINIDAE. The Eastern Swallow, *Hirundo rustica gutturalis,* is well known as a winter visitor to the Maldives; a party of 3 appeared in Addu Atoll on the evening of 14 October and another party of about 20, accompanied by several Sand Martins, *Riparia riparia,* on the evening of 3 November (1958). This second party remained in the atoll for some weeks and then disappeared. Did it (and the October birds) return northwards or did it pass on southwards to the Chagos Islands?

TURDIDAE. The most interesting of all the migrants and wanderers that appeared in Addu Atoll were the Wheatears. On the afternoon of 16 November (1958), a single Pied Wheatear, *Oenanthe leucomela leucomela*, was observed on the southern beach of Gan Island (Addu Atoll), almost the extreme southerly point of the Maldives; on the 23rd afternoon, although there were no Wheatears present in the morning, a party of one Pied Wheatear and two Isabelline *O. isabellina isabellina* was on the southern beach at 16 hours; they were just above the tide line and gave one the impression that they had just arrived from overseas. Later, on 14 December, another Pied Wheatear appeared close to where the others had been seen. All these birds gave one the impression that they had just arrived from the south but they could have come from other islands in Addu Atoll or from Suadiva Atoll to the north. As far as can be ascertained, they are the only wheatears ever to have been observed in the Maldive Islands.

MOTACILLIDAE. It has already been recorded (Phillips & Sims, 1958) that a Yellow Wagtail, *Motacilla flava*, was observed on a ship passing between Addu Atoll and the Chagos Islands on the 10 April 1957, so it was hoped that more of these wagtails would be observed passing through Addu Atoll in 1958/59. In fact, only a single Grey Wagtail, *M. cinerea*, was observed on 17 December and no Yellow Wagtails appeared that year but, in 1961, small numbers were observed in Gan (Addu) by J. J. Latham between 28 October and 18 November. All these birds disappeared almost at once, so it seems likely that they may have passed on farther south. Another Redthroated Pipit, *Anthus cervinus*, was collected in Gan (Addu) on the 8 December and several pipits were observed by J. J. Latham in 1961 on 22 September, 12 October, and 7 and 18 December, indicating that small numbers, of Pipits not only visit the Maldives annually, but that some of them pass southwards at any rate as far south as the extreme southernmost tip of the archipelago. Whether any of them (and the wagtails) pass on farther south to the Chagos Islands must await further investigation in the Chagos Islands. There is every indication that some do so.

TABLE SHOWING THE APPROXIMATE DATES OF CASUAL VISITORS TO ADDU AND NORTH MALÉ ATOLLS

'A' denotes Addu Atoll; 'M' denotes North Malé Atoll;
'S' denotes 'at Sea, close to the Maldives'

	June	July	August	September	October	November	December	January	February	March	April	May
Bulweria												
bulwerii			A									
Ardea												
purpurea		A			A	A	A	A				
Ixobrychus												
sinensis						A	A					
cinnamomeus			A		A		M			A		
Botaurus												
stellaris							A					
Plegadis												
falcinellus					A			A				
Aythya												
nyroca							A					
Nettapus												
c. coromandelianus							A					
Pernis												
apivorus orientalis							A					
Pandion												
haliaetus		A										
Falco												
peregrinus					A		A					
amurensis						A	A					
n. naumanni					A A	A A	A A					
Charadrius												
asiaticus						A						
Capella												
megala							A					
Xenus												
cinerea						A	A					
Philomachus												
pugnax					A	A						
Himantopus												
himantopus						A						
Chlidonias												
leucoptera						A	A					

	June	July	August	September	October	November	December	January	February	March	April	May
Sterna												
albifrons praetermissa						A						
Cuculus												
canorus								A A				
Cacomantis												
merulinus passerinus						A		A				
Collocalia												
brevirostris						A	M	A				
Apus												
affinis							A					
apus						A						
Merops												
apiaster								A A	A A	A A		
Oenanthe												
isabellina						A						
leucomela leucomela						A	A					
Tchitrea												
paradisi					A							
Motacilla												
cinerea							A					
flava						A A	A					S
Anthus												
t. trivialis							M					
cervinus				A	A		A A M					
Riparia												
riparia						A						
Lanius												
cristatus						A						
Sturnus												
vulgaris							S					

ANNOTATED SYSTEMATIC LIST OF THE BIRDS OF THE MALDIVES

(*including all records from and from the vicinity of the Archipelago*)

The following abbreviations are used in this list: M. = Maldivian; (P. & S.) = Phillips & Sims; (P.) = Phillips; (G. & G.) = Gadow & Gardiner; (G. S. & L. F.) = Georg Scheer & L. Franzisket; (J. J. L.) = J. J. Latham.

PROCELLARIIDAE

Oceanites oceanicus (Kuhl) : Wilson's Petrel. (M.=*Kurangee*)

Sight record only. One identified at sea (28 November 1956) less than 100 miles to the east of Malé Atoll. Well known to the Maldivians who state that large numbers frequent the sea around the atolls from April to October. Normally does not enter the lagoons.

Procellaria lherminieri bailloni Bonaparte : Audubon's Shearwater. (M.=*Hoogula*)

Collected in North Malé Atoll (P. & S.) and in Fadiffolu Atoll (G. S. & L. F.). Observed in small numbers in the Equatorial Channel between Addu and Suadiva Atolls. Breeds December and January and possibly throughout the year.

Procellaria pacifica Gmelin : Wedgetailed Shearwater. (M.=*Bodu-Hoogula*)

Sight record only. Small numbers observed in the Equatorial Channel, between Addu and Suadiva Atolls, in March (25th), May, and June 1958. Reported by the Maldivians to frequent the seas adjacent to the atolls during the period April to October but, normally, does not enter the lagoons.

Procellaria carneipes (Gould) : Pinkfooted Shearwater. (M.=*Ma-Hoogula*)

Sight record only. Several observed in the Equatorial Channel, in March (26th) and July (6th) 1958. Large shearwaters of this type are reported by the Maldivians to frequent the seas adjacent to Addu Atoll but, normally, they do not enter the lagoons. It is probable that some of the birds seen were Whitefronted Shearwaters (*P. leucomelaena* Temminck) which also occur in this area of the Indian Ocean.

Bulweria bulwerii (Jardine & Selby) : Bulwer's Petrel. (M.=*Kurangee*?)

A single female was caught, in an exhausted condition, in Addu Atoll on the evening of 22 August 1958; the first record for the Indian Ocean. The species is not known to the Maldivians.

PHAËTHONTIDAE

Phaëthon lepturus lepturus Daudin : Longtailed Tropic-Bird. (M.=*Dandfulu-Doonie*)

Collected in North Malé (P. & S.); in Addu (P.) and in Suadiva and Fadiffolu Atolls (G. S. & L. F.). Plentiful and resident throughout the

Archipelago. Breeds from November to January and probably later in the year.

SULIDAE

Sula leucogaster rogersi Mathews : Brown Booby. (M.=*Ma-Doonie*)

One female collected in Addu Atoll (P.) and a captive, from Fadiffolu Atoll, examined and measured in Malé (P. & S.). Reported by Maldivians to occur in numbers in Suadiva Atoll and observed in North Malé Atoll (P.). Specimens from the Maldives and from the Laccadives, in the British Museum, are very close to specimens from the Solomon Islands and Borneo. They have larger and heavier bills than those from Aden and the Red Sea which have been referred to the nominate race *leucogaster* (Boddaert).

Sula dactylatra Lesson : Masked Booby or Gannet. (M.=*Ma-Doonie*)

Sight record only. Two observed, end of November 1958, in North Malé Atoll (P. & S.); one observed and photographed on 28 November 1962, at Gan (Addu) (J. J. L.). Reported by Maldivians to occur, frequently, in Suadiva Atoll. Status uncertain.

FREGATIDAE

Fregata minor (Gmelin) : Larger Frigate Bird. (M.=*Hora* or *Ma-Hora*)

Sight record only. Small numbers observed over Malé, North Malé Atoll, during December 1956 and January 1957 (P. & S.). Several observed over Addu Atoll during 1958 (P.) and during May and June 1961 (J. J. L.). Appears to be a frequent visitor to the atolls but status uncertain.

Fregata ariel iredalei Mathews : Lesser Frigate Bird. (M.=*Hora* or *Ma-Hora*)

2 females collected from Mahlosmadulu (P. & S.) and 2 from Suadiva Atoll (P.). In Addu Atoll, 36 were observed hanging in the sky over a reef on the morning of 8 June 1958 (P.). Plentiful around most atolls and probably resident in some; but breeding observed only in Mahlosmadulu, during October and November (G. & G.).

ARDEIDAE

Ardea cinerea rectirostris Gould : Grey Heron. (M.=*Markana*)

Collected in North Malé (P. & S.), Addu (P.), Gaha Faro, Ari, and Addu (G. S. & L. F.). Plentiful and resident in all atolls. Breeding observed during June, July, August, November, December, January, and February.

Ardea purpurea Linnaeus : Purple Heron. (M.=*Markana*)

Male, in sub-adult plumage, collected in Addu Atoll on 3 November, 1958 (P.). Others observed on 14 July, 23rd and 31 October, 5 November, 19 November (2), 29 December, and 18 January (J. J. L.). Status uncertain, probably a frequent visitor. Specimen is probably of the race *manilensis* Meyen but sub-adults are difficult to determine, with certainty.

Butorides striatus didii Phillips & Sims : Central Maldivian Little Heron. (M.=*Rabonde*)

Collected in North Malé Atoll; plentiful, breeds during December and January (P. & S.). A well-marked, pale race with the crest, crown-patch, and eye-stripe greatly reduced. Meets the darker form, *albidulus* to the south and a considerably darker form, more akin to *javanicus* (Horsfield), to the north. Probably *javanicus* has invaded the Laccadives from India and has spread into the northern atolls of the Maldives where interbreeding with *didii* has occurred. More collecting in the intervening atolls is necessary before the exact range of each race can be worked out.

Butorides striatus albidulus Bangs : Southern Maldivian Little Heron. (M.=*Rabulli*)

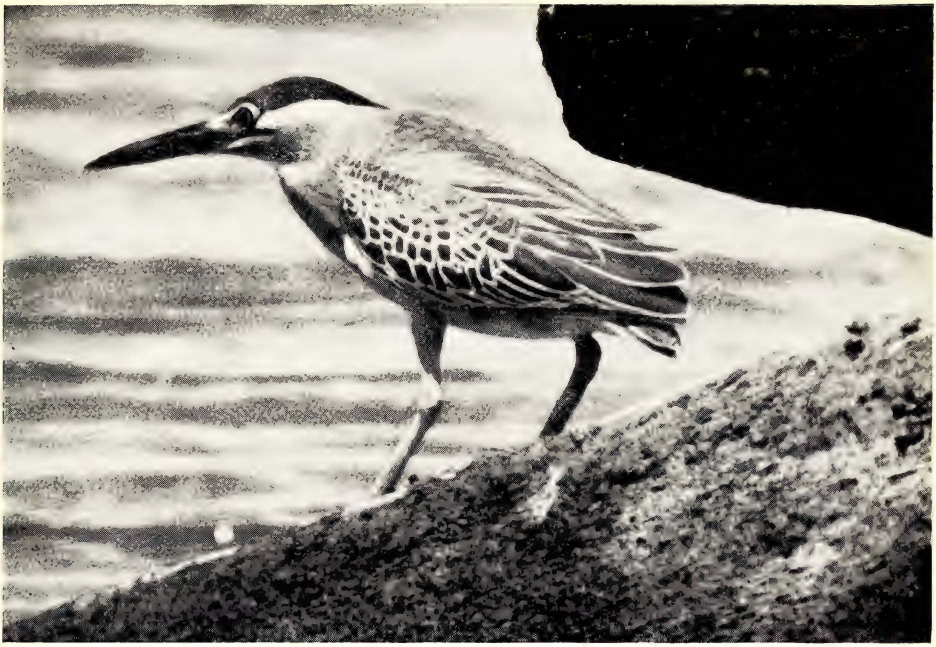
Collected in Addu and observed in Suadiva Atoll (P.). Plentiful in southern atolls but northern limits of range not ascertained. Breeding observed during January, February, September, October, and November. This race is considerably darker than *didii*; the crest, crown-patch, and eye-stripe are well defined but not as dark as in *javanicus*. Comparisons with *albolimbatus* Reichenow, from Diego Garcia in the Chagos Islands have not been made owing to lack of specimens.

Egretta garzetta (Linnaeus) : Little Egret. (M.=*Irruwar-Hudu*)

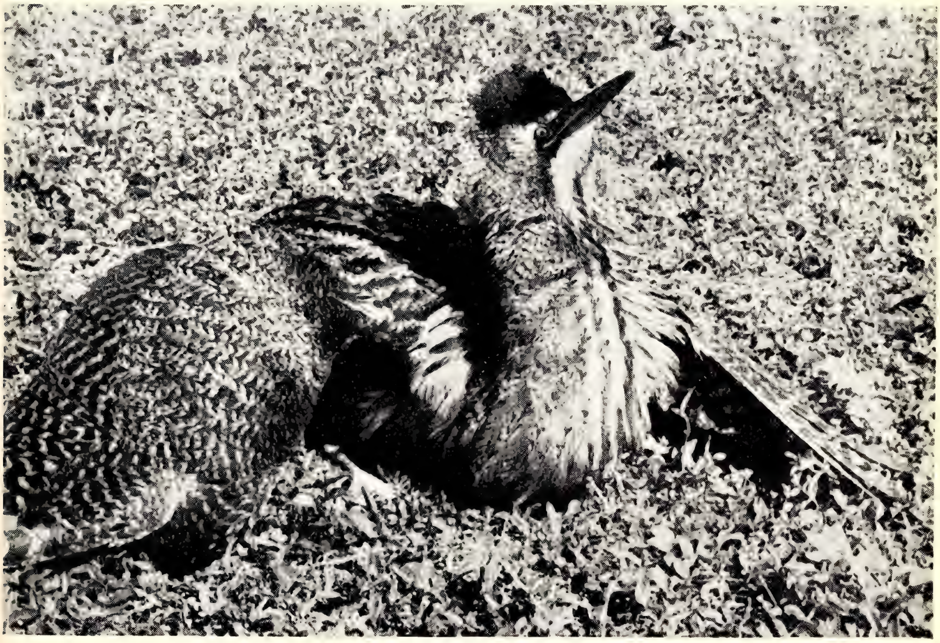
Sight record only. Two in captivity in Addu Atoll and one observed in South Mahlosmadulu Atoll (G. & G.). One observed in Addu Atoll (G. S. & L. F.). Status uncertain; probably an occasional winter visitor.

Egretta alba modesta (J. E. Gray) : Eastern Large Egret. (M.=*Hudu-Markana*)

A male collected on 20 December 1958, on Gan Addu), and

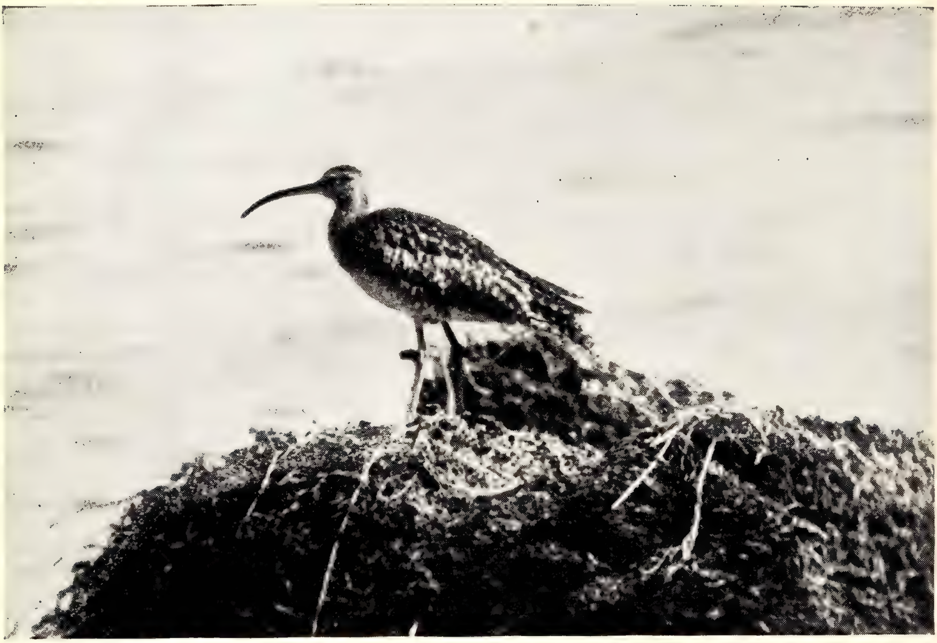


Southern Maldivian Little Heron (*Butorides striatus albidulus*), Gan, Addu Atoll, page 566

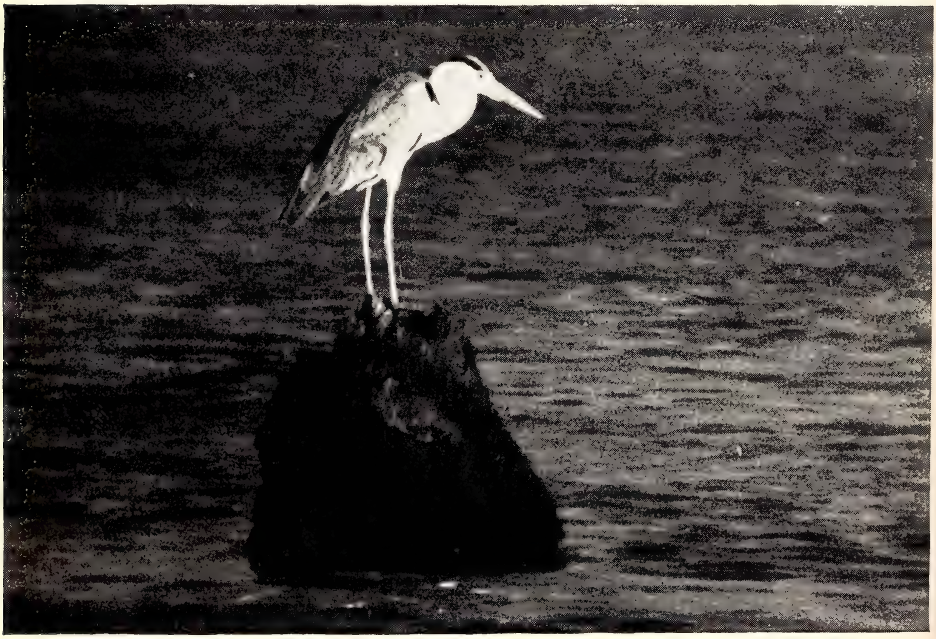


Common Bittern (*Botaurus stellaris*), Gan, Addu Atoll, page 567

Photos : A. J. H. Cobon



Whimbrel (*Numenius phaeopus*), Gan, Addu Atoll, page 573



Grey Heron (*Ardea cinerea rectirostris*), Gan, Addu Atoll, page 565

Photos: A. J. H. Cobon

another observed on 31 January 1959 (P.). Maldivians state, it is a frequent winter visitor.

Bubulcus ibis coromandus (Boddaert) : Eastern Cattle Egret. (M. = *Irruwar-Hudu*)

2 males collected in North Malé Atoll in December 1956 (P. & S.); 4 observed in Addu Atoll on 5 February 1961 were believed to have been bred, locally, in September 1960 (J. J. L.). Stated by Maldivians to be a frequent visitor.

Ardeola grayii grayii (Sykes): Indian Pond Heron. (M. = *Hudu-Rabonde*)

One collected in Fadifollu Atoll (G, S. & L. F.). Status unknown, probably a straggler.

Ardeola grayii phillipsi Scheer : Maldivian Pond Heron. (M. = *Hudu-Rabulli*)

Collected in Addu Atoll, where abundant, and observed in Suadiva Atoll (P., G. S., & L. F.). Appears to be confined, as a resident, to Addu and Suadiva atolls.

Ixobrychus sinensis (Gmelin) : Little Yellow Bittern. (M. = *Rabulli* or *Rabonde*)

Sight record only. One flushed from dense reeds on Medu Island, Addu Atoll, on 8 November 1958 and another a few weeks later (P.). Status unknown.

Ixobrychus cinnamomeus (Gmelin) : Chestnut Bittern. (M. = *Ratu Rabonde*)

Male collected in North Malé Atoll in December 1956 (P. & S.). One observed in Addu Atoll on 5 March, 2 on 30 August, and one on 31 October 1961 (J. J. L.). Status uncertain; reported by Maldivians to be an occasional visitor.

Dupetor flavicollis flavicollis (Latham) : Black Bittern. (M. = *Karlu Rabonde*)

2 males collected and others observed in North Malé Atoll during December 1956 and January 1957 (P. & S.). 3 together in Addu on 4 June 1958 (P.) and one 10 March 1961 (J. J. L.). Status uncertain, probably occasional visitor.

Botaurus stellaris (Linnaeus) : Common Bittern. (M. = ? ?)

One caught and photographed on Gan (Addu) on 25 October, another on 15 November, and a third on 27 December 1961 (J. J. L.). Status uncertain, probably a rare vagrant.

PLATALEIDAE

Plegadis falcinellus (Linnaeus) : Glossy Ibis. (M.= ? ?)

Sight record only. One observed on Gan (Addu) on 10 January 1959 (P.); another on 23 October 1961 (J. J. L.). Status uncertain, probably a rare vagrant.

ANATIDAE

Anas crecca Linnaeus : Common Teal. (M.=*Ratu Rairu*)

Sight record only. Observed in South Mahlosmadulu and Miladumadulu Atolls (G. & G.). Status uncertain; probably an occasional winter visitor to the northern atolls.

Anas querquedula Linnaeus : Garganey. (M.=*Rairu*)

A captive female examined and small flocks up to 25 frequently observed in Addu Atoll from 3 October to 17 January 1959 (P.). Reported by Maldivians to be a regular visitor to Addu Atoll during the northern winter period.

Anas acuta (Linnaeus) : Pintail. (M.=*Rairu*)

Sight record only. Several observed in Addu Atoll during October and December 1958 (P.). Status unknown.

Spatula clypeata Linnaeus : Shoveller. (M.=*Rairu*)

A male, in immature plumage, collected and small parties up to 7 observed in Addu Atoll, from 5 November 1958 to 17 January 1959 (P.). Probably a regular winter visitor, in small numbers.

Aythya fuligula (Linnaeus) : Tufted Duck. (M.=*Rairu*)

2 females examined, in captivity, in North Malé Atoll, during November 1956 (P. & S.). Reported by Maldivians to be a fairly frequent winter visitor to Malé Island reefs.

Aythya nyroca nyroca (Güldenstädt) : Ferruginous Duck. (M.=*Rairu*)

A single female collected on Gan, Addu Atoll, on 5 November, 1958 (P.). Status unknown; probably a vagrant.

Nettapus coromandelianus coromandelianus (Gmelin) : Cotton Teal. (M.=*Rairu*)

A single female collected on Gan, Addu Atoll, on 8 December 1958 (P.). Status unknown; probably a vagrant.

FALCONIDAE

Buteo sp.: Buzzard. (M = *Bazzu*)

Sight record only. On 14 January 1959, a Buzzard was observed flying over Gan, Addu Atoll; it was being mobbed by 30 or more White Terns (*Gygis alba monte*) and was too far away for identification of the species (P.). Another was observed in Suadiva Atoll (G. S. & L. F.). Status unknown.

Pernis apivorus orientalis Taczanowski: Siberian Honey Buzzard. (M. = *Bazzu*)

A single male collected in Gan, Addu Atoll, on 4 December 1959 (P.). This specimen agrees well with a male in the British Museum from 'the hills south of Samarkand'. Status unknown; probably a vagrant.

Circus aeruginosus (Linnaeus): Marsh Harrier. [M. = *Bazzu* (male); *Ahunda* (female)]

Sight record only. Adult male observed in North Malé Atoll on 26 December 1956 (P. & S.); several on Gan (Addu) during 1961 (J. J. L.). Reported by Maldivians to be an occasional visitor.

Circus macrourus (S. G. Gmelin): Pallid or Pale Harrier. (M. = *Bazzu*)

A first winter female collected on Gan, Addu Atoll, on 11 January, 1959 (P.). One collected on Fadiffolu Atoll (G. S. & L. F.). Status—see under next species.

Circus pygargus (Linnaeus): Montague's Harrier. (M. = *Bazzu*)

Male and female, both in first winter plumage, collected on Gan, Addu Atoll, on 6 December 1958 and 13 January 1959, respectively. Small numbers of harriers (*C. macrourus* and *C. pygargus*) all in female or immature plumage, recorded on Gan from 12 November 1958 to 14 March 1959 (P.) and again in 1961 (J. J. L.). Gardiner recorded both this and the last species as very common 'from October to February in the northern parts of the Maldives'. Both species are regular winter visitors; the majority are in first winter plumage.

Pandion haliætus (Linnaeus): Osprey. (M. = *Bazzu*)

Sight record only. One observed fishing off the southern coast of Gan (Addu), in July 1960 (J. J. L.). Probably a vagrant.

Falco peregrinus Tunstall: Peregrine Falcon. (M=*Bazzu*)

Sight record only. A large, dark falcon, which appeared to be an immature female, observed on Gan (Addu) on 14 October 1958 (P.); others observed on 12th and 18 December 1961 (J. J. L.). Appears to be an infrequent visitor.

Falco vespertinus amurensis Radde: Eastern Redlegged Falcon. (M.=*Sirumuthi*)

Male and female collected on Gan (Addu) on 5th and 14 December 1958, respectively (P.); others seen on 26 November and 12th to 14 December 1961 (J. J. L.). Feeds upon large grasshoppers and locusts, chiefly upon *Catantops pinguis innotabilis* (P.). Appears to be a winter visitor, in small numbers.

Falco naumanni naumanni Fleischer: Lesser Kestrel. (M.=*Sirumuthi*)

First year male and a female collected on Gan (Addu) on 12th and 15 December 1958; several others observed from 12 November to 21 December (P.); others observed from 8 October to 26 November 1961 (J. J. L.). Feeds chiefly upon large grasshoppers (*C. p. innotabilis*) and small *Calotes* lizards (P.). Probably an annual winter visitor.

Falco tinnunculus tinnunculus Linnaeus: European Kestrel. (M.=*Sirumuthi*)

Female collected in North Malé Atoll in February 1957 (P. & S.); others collected in Ari Atoll, Radu Atoll, and Gaha Faro (G. S. & L. F.). Observed on Gan (Addu) from 22 October to 18 December 1961 (J. J. L.). An annual winter visitor in moderate numbers.

RALLIDAE

Amaurornis phoenicurus phoenicurus (Pennant): Ceylon Swamp-Hen or Whitebreasted Waterhen. (M.=*Cumbilli*)

Collected in Addu Atoll (P.); in Ari, Rasdu; Gaha Faro, Miladumadulu and Fadiffolu Atolls (G. S. & L. F.). Resident in all atolls, both to the north as well as to the south of Malé Atoll. Breeds in Addu, May to September and frequently later (P.). This race appears to inhabit the whole of the Maldives with the exception of the Malé Atolls where the next race is resident. Specimens from Addu show a marked tendency towards enlargement of the white areas and frequently have odd white feathers, but most of them are so similar to typical *phoenicurus* from Ceylon that I am unable to separate them.

Amaurornis phoenicurus maldivus Phillips & Sims : Maldivian Swamp-Hen or Whitebreasted Waterhen. (M. = *Cumbilli*)

Collected in North Malé Atoll, in 1957, where it is resident (P. & S.). Breeds from May or June to August and September. This race appears to be confined to North and South Malé Atolls and to their vicinity.

Gallicrex cinerea (Gmelin) : Watercock. (M. = *Coolie-Kukulu*)

A single female was collected in North Malé Atoll (P. & S.); one seen in Addu Atoll (G. S. & L. F.). Reported by Maldivians to be resident in the more northerly atolls.

CHARADRIIDAE

Chettusia gregaria (Pallas) : Sociable Plover. (M. = ? ?)

The Sociable Plover was reported to visit the Maldives (P. & S.) but it is now considered probable that the informant confused it with the Pratincole, *Glareola pratincola* (see below). It should, therefore, be deleted from the list of Maldivian Birds, pending confirmation.

Charadrius hiaticula tundrae (Lowe) : Arctic Ringed Plover. (M. = *Findon*)

A single male collected in North Malé Atoll in December 1956 (P. & S.). 2 females collected in Gan (Addu) and several others observed from 17 November 1958 to 24 February 1959 (P.) and on 16 to 29 December 1961 (J. J. L.) The majority were in first-year plumage (P.). Appears to be an annual winter visitor, in small numbers.

Charadrius dubius jerdoni (Legge) : Little Ringed Plover. (M. = *Findon*)

One collected and several others observed in parties of 2 or 3 in Gan (Addu) from 10 November 1958 to 12 February 1959 (P.) and from 24th to 26 November 1961 (J. J. L.). Appears to be an annual winter visitor, in small numbers.

Charadrius alexandrinus Linnaeus : Kentish Plover. (M. = *Findon*)

Sight record only. Several observed on 18th and 19 November 1958 and again on 24 February 1959 on Gan (Addu) (P.). Status uncertain.

Charadrius mongolus atrifrons Wagler : Lesser Sand Plover. (M. = *Findon*)

3 collected and many observed, in small flocks, on Gan (Addu) from 24 August 1958 to 6 March 1959 (P.). One collected in North

Malé Atoll in December 1956 (P. & S.) and one in Fadiffolu Atoll (G. S. & L. F.). Appears to be a regular winter visitor, in considerable numbers.

Charadrius leschenaultii Lesson : Large Sand Plover. (M. = *Bondun*)

One collected and many observed, generally singly, on Gan (Addu), from September 1958 to March 1959; a few non-breeding birds were seen in May, June, and August (P.), and also in 1961 (J. J. L.). One collected in North Malé Atoll in December 1956 (P. & S.). A regular winter visitor, in small numbers.

Charadrius asiaticus asiaticus Pallas : Caspian Plover. (M. = *Bondun*)

A male and female collected, together, on Gan (Addu) on 10 November 1958 (P.). Status uncertain.

Pluvialis squatarola (Linnaeus) : Grey Plover. (M. = *Alaka*)

Collected in North Malé Atoll, where plentiful in winter (P. & S.). Very plentiful in Gan (Addu) from August to March but small numbers of non-breeding birds loiter throughout the year (P.). A regular winter visitor, in moderate numbers.

Pluvialis dominica fulva Gmelin : Asiatic Golden Plover. (M. = *Durrceen*)

Several collected and many observed, in flocks to about 50, on Gan (Addu) from 5 October 1958 to 21 March 1959 (P.) and from 29 December 1960 to 3 May 1961 (J. J. L.). Observed in North Malé Atoll (P. & S.), in Malé, Miladumadulu and Minicoy Atolls (G. & G.). A regular winter visitor, in considerable numbers.

Arenaria interpres interpres (Linnaeus) : Turnstone. (M. = *Ratafy*)

Very plentiful in Addu Atoll; flocks of 60+ arrive in late June and remain until the following March and April. Small numbers of non-breeding birds remain throughout the year (P.). Plentiful also in North Malé Atoll (P. & S.). Collected in Addu, Ari and Fadiffolu Atolls (G. S. & L. F.). The commonest of all the wintering waders; flocks of 150/200 in Gan (Addu) on 16 April and 13 September 1961 (J. J. L.).

SCOLOPACIDAE

Capella stenura (Bonaparte) : Pintail Snipe. (M. = *Durrceen Elolly*)

2 females collected and many more observed in Addu Atoll, from 4 October 1958 to 13 February 1959 (P.). Collected in North Malé

Atoll in December 1956 (P. & S.). Appears to be a regular winter visitor, in moderate numbers.

Capella megala (Swinhoe): Swinhoe's Snipe. (M. = *Durrceen Elolly*)

A single male collected in Medu Island, Addu Atoll, on 8 December 1958 (P.).

Capella gallinago gallinago (Linnaeus): Common Snipe. (M = *Durrceen Elolly*)

2 males and 2 females collected and several more observed in Addu Atoll from 15 December 1958 to end of January 1959 (P.). Reported to be 'extremely numerous in April 1900 on the mud-flats of Addu Atoll at low tide' by Gardiner who thought that it must breed in Addu Atoll but this is most unlikely. Appears to be a regular winter visitor.

Numenius arquata orientalis C. L. Brehm: Eastern Curlew. (M. = *Bodu Bulithumbi*)

A female collected on Gan (Addu) on 6 December 1958 and several more observed during December, and one on 9 March 1959 (P.); one on 22 March, 2 on 16 April, and others from May to November 1961 (J. J. L.). One observed in North Malé Atoll on 6 February 1957 (P. & S.). A regular winter visitor, in small numbers.

Numenius phaeopus phaeopus (Linnaeus): Whimbrel. [M. = *Bulithumbi* or (in Addu) *Bulithunga* or *Orana*]

Collected and observed in Addu Atoll where it is very plentiful, especially during the northern winter. A regular winter visitor, in large numbers; many non-breeding birds loiter throughout the year.

Limosa lapponica lapponica (Linnaeus): Bartailed Godwit. (M. = *Bulithumbi Elolly*)

A single bird observed, frequently, in Addu Atoll, from 6 June 1958 to 31 January 1959 (P.). A male collected in North Malé Atoll December 1956 (P. & S.). Appears to be a frequent visitor, chiefly during the winter.

Tringa glareola Linnaeus: Wood Sandpiper. (M. = *Findon Elolly*)

3 collected and several observed on Gan (Addu) between 12 August 1958 and 13 January 1959 (P.), 6 on Gan on 18 February 1961 (J. J. L.). Others observed in North Malé Atoll, December 1956 and January 1957 (P. & S.). Appears to be a regular winter visitor.

Tringa hypoleucos Linnaeus : Common Sandpiper. (M.=*Findon*)

Many observed in Addu Atoll from 10 August 1958 to 22 March 1959. A regular winter visitor, in moderate numbers, from August to April, to all Atolls.

Tringa totanus eurhinus (Oberholser): Eastern Redshank. (M.=*Ratafy Elolly*)

A male collected and small numbers observed in Addu Atoll between 20 November 1958 and 6 March 1959 (P.) and others observed in 1961 (J. J. L.). Collected and observed in North Malé Atoll in December 1956 (P. & S.). A regular winter visitor in small numbers.

Tringa nebularia (Gunnerus): Greenshank. (M.=*Chunchun Elolly*)

Many small parties observed in Addu Atoll, from early November 1958 to early March 1959 (P.) and again from the 16 June 1961 to the 20 January 1962 (J. J. L.). Collected and observed in North Malé Atoll during December 1956 and January 1959 (P. & S.). Collected in Addu and Miladumadulu Atolls (G. S. & L. F.). A regular winter visitor, in moderate numbers; some non-breeding birds loiter.

Xenus cinerea (Latham) : Terek Sandpiper. (M.=*Findon*)

A male collected on Gan (Addu) on 21 November and another observed on the 7 December 1958 (P.). A winter visitor; status uncertain.

Calidris minutus (Leisler) : Little Stint. (M=*Kirru Bondun*)

2 males collected and several observed on Gan (Addu) between 11 November 1958 and 31 January 1959 (P.) and between 13 November and 16 December 1961 (J. J. L.). A single male collected and one other observed in North Malé Atoll during December 1956 (P. & S.). A regular winter visitor, in small numbers.

Calidris temminckii (Leisler) : Temminck's Stint. (M.=*Kirru Bondun*)

Sight record only. One observed closely on Gan (Addu) from 23 to 26 May 1958 and others from 5 October to 11 November (P.). Status uncertain.

Calidris subminutus (Middendorff): Longtoed Stint. (M.=*Kirru Bondun*)

4 collected and small numbers observed, frequently, on Gan (Addu) between 17 November 1958 and 24 February 1959 (P.) and also on the 26th and 27 October 1961 (J. J. L.). Appears to be a winter visitor, in small numbers, to Addu Atoll.

Calidris alpinus alpinus (Linnaeus) : Dunlin. (M.=*Kirru Bondun* or *Findon*)

3 collected and others observed on Gan (Addu) between 25 November 1958 and 24 February 1959 (P.). Probably a regular winter visitor, in small numbers.

Calidris testaceus (Pallas) : Curlew-Sandpiper. (M.=*Findon*)

3 collected and large numbers, in flocks up to 100, observed in Addu Atoll from 25 June 1958 to middle March 1959 (P.) and also in 1961 (J. J. L.). Large numbers visit the Maldives in winter and small numbers, of non-breeding birds, loiter throughout the year.

Calidris albus (Pallas) : Sanderling. (M.=*Kirru Bondun*)

A single male collected and several others observed on Gan (Addu) between 15 November 1958 and 4 January 1959 (P.) and another 6 in March 1961 (J. J. L.). Status uncertain; a winter visitor.

Philomachus pugnax (Linnaeus) : Ruff. (M.=*Findon*)

A single sub-adult male visited Gan (Addu) from 3rd to 17 October 1958 and another, also in sub-adult plumage, was collected on 5 November (P.). Appears to be an occasional winter visitor.

RECURVIROSTRIDAE

Himantopus himantopus (Linnaeus) : Blackwinged Stilt. (M= ? ?)

Sight record only; one on the southern reef of Gan (Addu) on 5 November 1961 (J. J. L.). Status unknown, probably a vagrant.

GLAREOLIDAE

Glareola pratincola (Linnaeus) : Large Pratincole. (M.=*Abularge*)

A party of 3, in sub-adult plumage, visited Gan (Addu) from 4th to 7 October 1958 and another was observed on 5 November (P.). A broken egg was found on the Air-field on 14 December 1960, a pair was in the area from 14 December 1960 to 16 March 1961 and many were observed, in flocks to 25+, from 18 October 1961 to 27 January 1962 (J. J. L.). Probably a resident, moving from atoll to atoll. The race *maldivarum* was named by J. R. Forester, in 1795, from the description given previously by Latham (1785) of a bird taken at sea in about the same latitude as the Maldives; the Addu Atoll pratincoles were probably of the same race.

DROMADIDAE

Dromas ardeola Paykull: Crab Plover. [M.=*Eshunga* (Addu) or *Tayrawa* (Malé), *Moola Lumbo* (Juvenile)]

2 observed in Addu Atoll on 8 June 1958 (P.). Male collected and others, including juveniles, observed in North Malé Atoll in December 1956 and January 1957 (P. & S.). Collected in Addu, Suadiva, and Rasdu Atolls (G. S. & L. F.). Appears widespread and resident in small numbers.

STERCORARIIDAE

Stercorarius skua Brünnich: Great Skua. (M=*Bodu Hoogula*)

Sight record only. One observed, at close range, in Addu Atoll (J. J. L.). Almost certainly an Antarctic Skua as these skuas are well known as occasional visitors to the north Indian Ocean.

LARIDAE

Larus ridibundus Linnaeus: Blackheaded Gull. (M.= ? ?)

Sight record only. One visited Gan (Addu) from the 10 to 23 December 1961 (J. J. L.). An unusual wanderer.

Chlidonias leucoptera (Temminck): Whitewinged Black Tern. (M.= *Kirru Dooni*)

Solitary, sub-adult male collected in Addu Atoll on 8 November 1958 (P.) and 3 observed, feeding over flooded areas, on 10 to 16 December 1961 (J. J. L.). Probably an infrequent winter visitor.

Gelochelidon nilotica nilotica (Gmelin): Gullbilled Tern. (M.=*Kirru Dooni Amma*)

Female collected and others observed in North Malé Atoll during December 1956 and January 1957 (P. & S.); one observed off Addu Atoll on 29 March, another from 13 to 15 September 1961, and one from 21st to 25 January 1962 (J. J. L.). Appears to be resident in small numbers but status is uncertain.

Hydroprogne caspia (Pallas): Caspian Tern. (M.= ? ?)

Sight record only. 3 observed (separately) in North Malé Atoll on 30 November 1956 (P.); one in Addu Atoll on 18 April, 4 on the 22 September, and 4 on the 18 October 1961 (J. J. L.). Status uncertain; probably an occasional visitor.

Sterna hirundo tibetana Saunders : Tibetan Tern. (M.=*Kirru Dooni*)

2 females, in worn, sub-adult plumage, collected in Addu Atoll lagoon in January and February 1959 (P.). Status unknown; probably an occasional winter visitor.

Sterna dougallii korustes (Hume) : Eastern Roseate Tern. (M.=*Kirru Dooni*)

4 collected and others observed in North Malé Atoll during January 1957 (P. & S.). Status unknown; reported by Maldivians to breed during March/May with other terns.

Sterna sumatrana mathewsi Stresemann : Blacknaped Tern. (M.=*Kirru Dooni*)

Pair collected and large numbers observed in Addu Atoll (P.). Several collected and many observed in North Malé Atoll (P. & S.). Collected and observed by various observers in Ari, Rasdu, Gaha Faro, Fadiffolu, and Miladumadulu Atolls. The most abundant and widespread tern in the Maldives; breeds in Addu Atoll during June and July.

Sterna fuscata Linnaeus : Sooty Tern. (M.=*Walla* or *Walli*)

One collected in Addu Atoll (G. S. & L. F.). Large flocks observed between Ceylon and North Malé Atoll in late November 1956 (P. & S.). Reported by Maldivians to breed during March and April. Status uncertain; occurs in the vicinity of the Maldives at various times during the year.

Sterna anaethetus Scopoli : Bridled or Brownwinged Tern. (M.=*Walla* or *Walli*)

Sight record only. One observed over the southern reef of Gan (Addu) on 15 February, 1959 (P.). Large flocks observed at sea between Ceylon and North Malé Atoll in late November 1956 (P. & S.). Status uncertain; reported by Maldivians to breed in certain atolls during March and April.

Sterna albifrons praetermissa Baker : Mesopotamian Little Tern. (M.=*Bondu* or *Bondu Dooni*)

A single male collected in Addu Atoll on 15 November 1958 (P.). Status uncertain.

Sterna albifrons saundersi Hume : Blackshafted Little Tern. (M=*Bondu* or *Bondu Dooni*)

3 collected and very large numbers observed throughout the year in Addu Atoll (P.). 3 collected and many others observed in North

Malé Atoll (P. & S.). Resident in considerable numbers throughout the Maldives; reported by Maldivians to breed, with other terns, during April.

Thalasseus bergii velox (Cretzschmar): Large Crested Tern. (M.=*Gardooni*)

Collected and observed in small numbers in North Malé Atoll (P. & S.). Observed by various observers in Addu, Ari, Gaha Faro, and Fadiffolu Atolls. Appears to be resident and widespread, in small numbers; breeding reported by Maldivians in North Malé Atoll during April.

Thalasseus bengalensis bengalensis (Lesson): Indian Lesser Crested Tern. (M.=*Iam Mutie Gardooni*)

3 collected and many observed in Addu Atoll (P.). Collected and observed in small numbers in North Malé, Ari, and Rasdu Atolls by various observers. Appears to be resident, in moderate numbers; reported by Maldivians to breed, with other terns, in North Malé Atoll during April.

Anoüs stolidus pileatus (Scopoli): Common Noddy. (M.=*Maranga*)

Several collected and many observed, in Addu Atoll, throughout the year (P.); others collected, by various collectors, in Suadiva, Gaha Faro and North Malé Atolls. Breeding (one nest) observed in Addu Atoll in April (P.). Appears to be resident in large numbers but, as Maldivians have no knowledge of its breeding, may be only a visitor rarely staying to breed.

Anoüs tenuirostris (Temminck): White-capped Noddy. (M.=*Maranga*)

Gadow & Gardiner reported this species breeding in South Mahlosmadulu Atoll in November 1899 but its presence has not been recorded since. Status unknown.

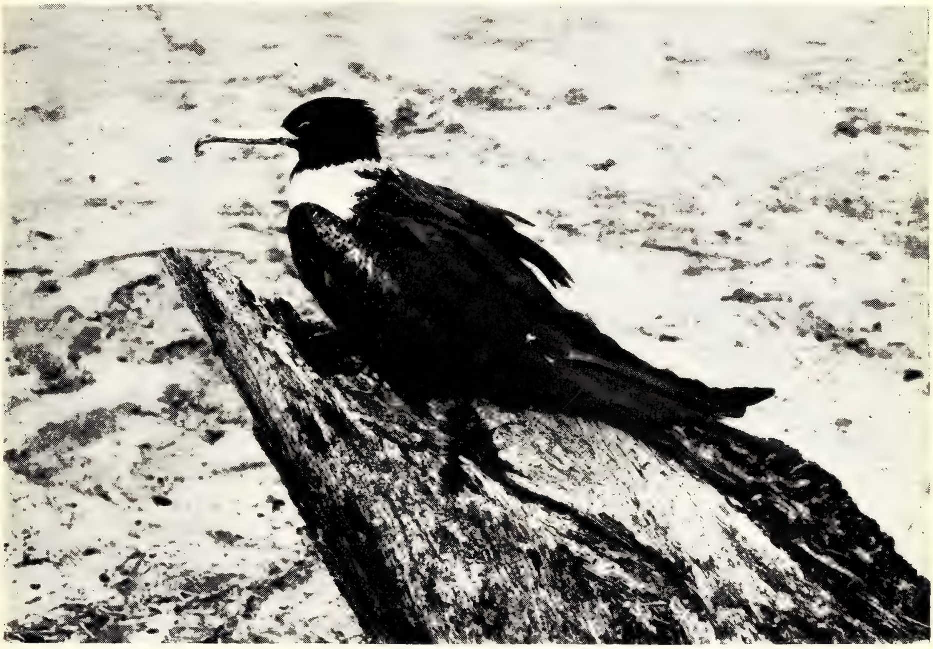
Gygis alba monte Mathews: White Tern or Fairy Tern. (M.=*Cundu Wallu Dooni*)

Collected and observed, in large numbers, in Addu Atoll to which atoll it is confined (P.). Breeds throughout the year.

PSITTACIDAE

Psittacula calthorpae (Blyth): Emeraldcollared Parakeet. (M.= ?)

Gardiner reported seeing a pair, twice, in January 1899, on Hulule Island, North Malé Atoll. His description of 'green parakeets, a little



Lesser Frigate Bird (*Fregata ariel iredalei*), Gan, Addu Atoll, page 565

White Tern (*Gygis alba monte*) juvenile, Gan, Addu Atoll, page 578

Photos : W. W. A. Phillips

bigger than a thrush and of a brilliant green colour all over' scarcely fits *Psittacula calthorpae* which, moreover, is confined to Ceylon, so it would appear that an error in identification has occurred. Possibly the birds were a pair of Indian Parakeets or Lorikeets that had strayed or been brought over from the mainland. The bird is not known to the Maldivians.

CUCULIDAE

Cuculus canorus Linnaeus : Common Cuckoo. (M.=*Dindin Koel*)

Sight record only. A cuckoo, which appeared to be a sub-adult *C. canorus,* was observed on 4 and 5 January 1959, on Gan (Addu) (P.). Another, extremely tame, frequented Gan (Addu) during the last three weeks of January 1961; it appeared to be of the Asiatic race *telephonus* (J. J. L.). Status uncertain.

Cacomantis merulinus passerinus (Vahl) : Indian Plaintive Cuckoo. (M= ?)

A single male, in sub-adult plumage, collected on Gan (Addu) on 13 January 1959 (P.); another observed on 9 November 1961 (J. J. L.). Appears to be a very unusual visitor.

Eudynamys scolopacea scolopacea (Linnaeus) : Koel. [M.=*Karlu Koel* (Male) ; *Dindin Koel* (Female)]

2 males collected on Gan (Addu) and several others, both males and females, observed in spite of the total absence of House Crows (*Corvus splendens maledivicus*). Koels in this atoll must either forego breeding or return to Suvadiva Atoll, over 30 miles to the north, to breed. Resident and widespread, in moderate numbers, throughout the archipelago. Eggs are laid in the nests of the Maldivian House Crow early in the year.

STRIGIDAE

Asio flammeus (Pontoppidan) : Shorteared Owl. (M.=*Bukhamoonu*)

Gardiner recorded this owl from Goifurfehendu Atoll in October 1899; from Miladumadulu in December; from North Malé in January and February, and from Addu and Suvadiva Atolls in April (G. & G.). Well known to Maldivians. Appears to be an irregular winter visitor, often in considerable numbers.

APODIDAE

Collocalia brevirostris (McClelland) : Edible-nest Swift. (M.=*Forika*)

Sight record only. One observed flying low and feeding over Malé, North Malé Atoll on 19 December 1956 (P. & S.) and another in the same area in 1957 (G. S. & L. F.). One appeared over Gan (Addu) on the 10 November 1961 and another on the 20 January 1962 (J. J. L.). Appears to be an occasional winter visitor although there are no caves or high buildings to attract it.

Apus affinis (J. E. Gray) : Whiterumped House Swift. (M.=*Forika*)

Sight record only. Party of 7 observed over a swamp on Gan (Addu) on 16 December 1961 (J. J. L.). Status unknown.

Apus apus (Linnaeus) : Common Swift. (M.=*Forika*)

Sight record only. One observed, flying southwards, moderately low over Gan (Addu) on morning of 1 November 1958 (P.). Status unknown; an unusual visitor.

MEROPIDAE

Merops apiaster Linnaeus : European Bee-eater. (M.= ?)

Sight record only. Party of 3 (an adult and 2 sub-adults) visited Gan (Addu) from 10 January to 31 March 1959; they lived mainly upon dragonflies (P.). Status unknown.

HIRUNDINIDAE

Hirundo rustica gutturalis Scopoli : Eastern Swallow. (M.=*Forika*)

Immature male collected from a flock of 20+ on Gan (Addu) on 3 November 1958 and others observed from 14 October 1958 to 17 January 1959 (P.); others observed in Gan (Addu) from 20 October to 18 December 1961 (J. J. L.). One collected and others observed in North Malé Atoll in December 1956 (P. & S.). Recorded from Minicoy on 1 September (G. & G.). An annual winter visitor.

Delichon urbica (Linnaeus) : House Martin. (M.=*Forika*)

Sight record only. One observed over Gan (Addu) on 28 November 1961 (J. J. L.). Several seen over North Malé Atoll from end January to end February 1898 (G. & G.). An irregular winter visitor, sometimes in moderate numbers.

Riparia riparia (Linnaeus) : Sand Martin. (M.=*Forika*)

Sight record only. Several observed, flying with swallows, over Gan (Addu) on 3 and 4 November 1958 (P.). Status unknown.

TURDIDAE

Oenanthe isabellina (Temminck) : Isabelline Wheatear. (M.= ?)

A male collected and another observed on Gan (Addu) on 23 and 24 November 1958 (P.). Status unknown.

Oenanthe leucomela leucomela (Pallas) : Pied Wheatear. (M.= ?)

2 males and a female collected on Gan (Addu) on 16 and 24 November and 14 December 1958 (P.). Status unknown.

MUSCICAPIDAE

Tchitrea paradisi (Linnaeus) : Paradise Flycatcher. (M.= ?)

Sight record only. A single female or immature male was observed on Gan (Addu) on 27 October 1961 (J. J. L.). Status unknown.

MOTACILLIDAE

Motacilla cinerea Tunstall : Grey Wagtail. (M.=*Fanfoudooni*)

Sight record only. One on Gan (Addu) on the morning of 17 December 1958 (P.). Status unknown.

Motacilla flava Linnaeus : Yellow Wagtail. (M.=*Fanfoudooni*)

Sight record only. A male settled on a ship, approx.: 45 miles south of Addu Atoll on 10 April 1957; it was in fresh plumage with a bluish head and appeared to be of the race *beema* (P. & S.). An immature visited Gan (Addu) on 1 November and another, answering to the race *thunbergi*, was present on the 28th and 29 October, while 4 or 5 others appeared on the 27 October, and one on the 18 November 1961 (J. J. L.). Appears to be an irregular winter visitor, in small numbers; is well known to the Maldivians.

Anthus trivialis trivialis (Linnaeus) : Tree Pipit. (M.=*Fanfoudooni*)

A single female collected on Malé, North Malé Atoll, in December 1956 (P. & S.). Status unknown. Maldivians report that small numbers of pipits appear annually during November and December; some are probably of this species.

Anthus cervinus (Pallas) : Redthroated Pipit. (M. = *Fanfoudooni*)

An immature male collected on Gan (Addu) on 8 December 1958 (P.); and other pipits, believed to be of this species, observed on Gan (Addu) on 22 September, 12 October, and 18 December 1961 (J. J. L.). A single male collected on Malé, North Malé Atoll, in December 1956 (P. & S.). Small numbers of pipits visit the Atolls annually, during the northern winter period; it is probable that the majority are of this species but further collecting is desirable.

LANIIDAE

Lanius cristatus (Linnaeus) : Brown Shrike. (M. = ?)

Sight record only. One, in immature plumage, visited Gan (Addu) from 20 November 1961 to 2 January 1962 (J. J. L.). Status unknown.

STURNIDAE

Sturnus vulgaris Linnaeus : Common Starling. (M. = ?)

Sight record only. One identified at sea, about 40 miles to the west of Minicoy (Minikai) Island, on 10 December 1954 (Jan. 1955). Status unknown.

CORVIDAE

Corvus splendens maledivicus Reichenow : Maldivian House Crow (M. = *Karlu*)

4 collected in Malé, North Malé Atoll, and many more observed 1956/57 (P. & S.). Resident and abundant throughout the archipelago with the exception of Addu Atoll from where it is excluded by the mass attacks of the White Terns (*Gygis alba monte*). Breeds during December and January and probably during other months.

NOTE: Several other small passerine birds were seen on Gan (Addu) during 1961/62 by Mr. Latham and others but they have not been included in this paper as they were not satisfactorily identified.

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SUMMARY

1. A short history of the ornithology of the Maldive Islands is given, together with a brief description of the atolls, their situation, climate, fauna and flora, and the general conditions governing the survival of the resident birds.

2. Some details of the breeding of 13 resident species are given, together with a table showing the approximate dates of breeding, observed and conjectured.

3. Migration to the Maldives is discussed, and details of arrival and departure dates of over 60 migrants are given, the great majority of which are winter visitors from the north. The suggestion is put forward that, for some of these migrants to the Maldives, Addu Atoll (the extreme southern-most atoll) is not the terminus of their southward flight, indications having been collected that point to some exchanges of bird life between Addu Atoll and the Chagos Archipelago to the south.

4. An annotated, systematic list of Maldivian birds, complete as far as our present knowledge permits, gives the status (known or presumed) of the 113 species and subspecies that have been recorded from the archipelago.

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The Butterflies of South Gujarat

BY

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The term South Gujarat, as used throughout this paper, comprises the Dangs and the districts of Broach and Surat. The Dangs, where the majority of species were collected, consists of a tract of hilly teak and bamboo country south of Tapti River which lies between the Nasik-Khandesh Deccan and the South Gujarat plain. This area has tropical moist deciduous and tropical semi-evergreen plant life with an annual average rainfall of 80 inches. The Dangs forest with its mountain streams, hills, valleys, and plateaux supports a wide variety of flowering plants attractive to many species of butterflies. In this pan-tropical terrain with its seasonal and altitudinal differences the writer between October 1952 and March 1963 has collected thousands of butterflies. Less intensive collecting was done between March 1946 and March 1963 in Surat and Broach districts.

The following is a list of the species collected together with such field notes as are available. The latest work on Indian butterflies is Wynter-Blyth's BUTTERFLIES OF THE INDIAN REGION (1957); where my records appear to add anything to the information already available, I have quoted the distribution as in Wynter-Blyth in parenthesis.

DANAIDAE

Danaus aglea aglea (Cramer) : The Glassy Tiger

Fairly common throughout the year.

(South India to Poona. Himalayas east from Kashmir, Assam, Burma, Bengal.)

Danaus limniace mutina Fruh. : The Blue Tiger

Common throughout the year.

Danaus melissa dravidarum Fruh. : The Dark Blue Tiger

One netted on 18 October 1952 at Ahwa; another on 19 March 1963 at Ahwa.

(Ceylon. South India.)

Danaus genutia Cramer : The Common Tiger

Common throughout the year.

Danaus chrysippus (Linnaeus) : The Plain Tiger

Very common throughout the year.

Euploea core core (Cramer) : The Common Indian Crow

Very common throughout the year.

Euploea crassa kollari Felder : The Brown King Crow

In September and October in South Gujarat. Rare. Uncommon further south in the Konkan.

SATYRIDAE

Mycalesis perseus (Fabricius) : The Common Bushbrown

Very common throughout the year.

Mycalesis mineus polydecta Cramer : The Dark-brand Bushbrown

From July to October, fairly common. Occasionally at lights during the south-west monsoon.

(Peninsular India south of Bombay. Madhya Pradesh and Bengal, Kulu to Assam and Burma.)

Lethe europa ragalva Fruh. : The Bamboo Treebrown

September to December. Rare.

Lethe rohria nilgiriensis Guerin : The Common Treebrown

October to January. Not common.

Ypthima hubneri hubneri Kirby : The Common Fourring

Common throughout the year.

Ypthima baldus Fabricius : The Common Fivering

From July to January only; common.

Ypthima asterope Klug : The Common Threering

Common throughout the year.

Melanitis leda (Drury) : The Common Evening Brown

Common throughout the year. It has wet and dry season forms and is crepuscular in its habits. Wet season form *determinata* frequently netted at lights.

NYMPHALIDAE

Charaxes polyxena imna Butler : The Tawny Rajah
February to April. Uncommon to rare.

Charaxes fabius fabius (Fabricius) : The Black Rajah
In some years fairly common from October to April.

Eriboea athamas (Drury) : The Common Nawab
Fairly common from October to April.

Euthalia garuda (Moore) : The Baron
Common throughout the year.

Euthalia evalina laudabilis Swin. : The Redspot Duke
September and October. Not common.
(S. India.)

Euthalia nais (Forster) : The Baronet
Common throughout the year.

Neptis columella Cramer : The Short-banded Sailer
February to April. Not common.

Neptis hylas Linnaeus : The Common Sailer
Very common throughout the year. It has distinct dry and wet season forms.

Neptis jumbah Moore : The Chestnut-streaked Sailer
One captured on 14 March 1963 at Ahwa in the Surat Dangs.
(Ceylon. S. India. Bengal. Burma.)

Cyrestis thyodamas indica Evans : The Common Map
Very rare in South Gujarat.

Hypolimnas bolina (Linnaeus) : The Great Eggfly
Common throughout the year.

Hypolimnas misippus (Linnaeus) : The Danaid Eggfly
Common throughout the year.
♀ form *inaria*. August and September. Very rare.

Kallima philarchus horsfieldii Kollar : The Blue Oakleaf

Common from February to June; otherwise scarce. In April 1956 I collected forty specimens in two hours in a valley close to the mission bungalow at Ahwa.

(Confined to the western side of south India from Nasik and near Bombay southwards. Not rare from Matheran to Kanara.)

Precis hierta hierta (Fabricius) : The Yellow Pansy

Very common throughout the year. At 9.00 p.m. on 17 February 1963 I caught a female of this species flying around a petromax lamp in our mission bungalow. It is not normally crepuscular nor nocturnal in its habits.

Precis orithyia (Linnaeus) : The Blue Pansy

Very common throughout the year.

Precis lemonias (Linnaeus) : The Lemon Pansy

Very common throughout the year. I have a melanistic example of this species, caught in July 1960 at Ahwa on *Lantana* flowers, in which the ground colour on the upper surface is much darker than usual and the large ocelli on the hindwings are absent.

Precis almana almana (Linnaeus) : The Peacock Pansy

Common throughout the year.

Precis iphita (Cramer) : The Chocolate Pansy

Very common throughout the year.

Vanessa cardui (Linnaeus) : The Painted Lady

Very common throughout the year.

Vanessa indica (Herbst) : The Indian Red Admiral

Very rare in South Gujarat.

(Ceylon. Hills of South India. Coorg. Himalayas as far west as Kashmir, Hills of NE. India, Burma.)

Argynnis hyperbius (Johanssen) : The Indian Fritillary

Very rare in South Gujarat. Recorded on 9 April 1960 at Ahwa.

Atella phalantha (Drury) : The Common Leopard

Very common throughout the year.

Cirrochroa thais (Fabricius) : The Tamil Yeoman

Appearance in South Gujarat probably accidental. The sole specimen was netted on 27 September 1962 at Ahwa on *Lantana* flowers.

(Ceylon. Western Ghats. Coorg. Wynaad. Nilgiris. Palnis.)

Byblia ilithyia (Drury) : The Joker

My only record for South Gujarat is a specimen netted on 19 September 1957 in the mission garden at Ahwa.

Ergolis ariadne (Johanssen) : The Angled Castor

Fairly common throughout the year.

Ergolis merione merione (Cramer) : The Common Castor

Common throughout the year.

ACRAEIDAE

Telchinia violae (Fabricius) : The Tawny Coster

Throughout the year in the Surat Dangs but not common. Fairly common at Broach.

ERYCINIDAE

Libythea lepita lepitoides Moore : The Common Beak

Rare in South Gujarat.

(Ceylon and S. India, rare. Elsewhere common to very common.)[1]

Abisara echerius (Stoll) : The Plum Judy

Fairly common throughout the year.

LYCAENIDAE

Spalgis epius (Westwood) : The Apefly

Netted in July and August only; rare.

(Ceylon and S. India.)

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[1] Wynter-Blyth does not mention this subspecies. Evans in his IDENTIFICATION OF INDIAN BUTTERFLIES says that this subspecies occurs in Ceylon and S. India and is not rare.—EDS.

Castalius rosimon rosimon (Fabricius) : The Common Pierrot

Fairly common throughout the year.

Castalius caleta decidia (Hewitson): The Angled Pierrot

Not uncommon. October to March.
(Recorded from the Western Ghats south of Bombay.)

Castalius ethion ethion (Doubleday & Hewitson) : The Banded Blue Pierrot

October and November. Not common.
(Ceylon. S. India. Assam and Burma.)

Tarucus theophrastus indica Evans : The Pointed Pierrot

Fairly common during the winter months.

Tarucus extricatus Butler : The Rounded Pierrot

Common from March to July.

Syntarucus plinius (Fabricius) : The Zebra Blue

Common from November to July.

Azanus ubaldus (Cramer) : The Bright Babul Blue

September and October. Not common.

Azanus uranus Butler : The Dull Babul Blue

November and probably other months. Not common.

Azanus jesous gamra (Lederer) : The African Babul Blue

November and probably other months. Not common.

Neopithceops zalmora (Butler) : The Quaker

Collected on 15 November 1960 and 8 December 1962 at Ahwa. Rare.
(Ceylon. South India to Bengal. Kumaon to Burma. Andamans.)

Lycaenopsis puspa gisca Fruh. : The Common Hedge Blue

November to February. Not common.

Lycaenopsis albidisca Moore : The Whitedisc Hedge Blue

November, December, and January. Not common.
(Hills of S. India.)

Chilades laius laius (Cramer) : The Lime Blue
Common throughout the year.

Zizeeria putli Kollar : The Southern Grass Jewel
Common throughout the year.

Zizeeria maha Kollar : The Pale Grass Blue
Common from November to July.

Zizeeria lysimon Hub. : The Dark Grass Blue
Common from October to April.

Zizeeria gaika Trimen : The Tiny Grass Blue
Fairly common from November to April.

Zizeeria otis Fabricius : The Lesser Grass Blue
Common from October to April.

Euchrysops cnejus (Fabricius) : The Gram Blue
Common from October to April.

Euchrysops pandava pandava (Horsfield) : The Plains Cupid
Fairly common throughout the year.

Catochrysops strabo (Fabricius) : The Forget-Me-Not
Common throughout the year.

Lampides boeticus (Linnaeus) : The Peablue
Very common throughout the year.

Lycaenesthes lycaenina Felder : The Pointed Ciliate Blue
March to May in the Surat Dangs. Not common.

Jamides celeno celeno Cramer : The Common Cerulean
Common throughout the year.

Jamides bochus bochus Cramer : The Dark Cerulean
Very common throughout the year.

Nacaduba nora nora Felder : The Common Lineblue
Found throughout the year. Not common.

Curetis thetis (Drury) : The Indian Sunbeam

Fairly common throughout the year.

Curetis acuta dentata Moore : The Angled Sunbeam

Fairly common throughout the year.

Curetis bulis (Doubleday & Hewitson) : The Bright Sunbeam

Fairly common during the monsoon season; however, the dry season form *angulata* is more common than the above from October to April.

(S. India. Pachmarhi.)

Iraota timoleon timoleon (Stoll) : The Silverstreak Blue

Collected only in July, October, and November, rare.

Amblypodia amantes amantes Hewitson : The Large Oakblue

Fairly common from September to March.

Surendra quercetorum Moore : The Common Acacia Blue

Taken only in August and September. Probably rare.

(Ceylon. S. India. Simla Hills to Assam and Burma. S. Bihar.)

Spindasis vulcanus vulcanus Fabricius : The Common Silverline

From July to April only, fairly common.

Spindasis ictis ictis Hewitson : The Common Shot Silverline

From July to April only, fairly common.

Spindasis elima elima Moore : The Scarce Shot Silverline

November and December. Not common.

Spindasis lohita Horsfield : The long-branded Silverline

Taken only in July and November; rare.

(Mussoorie to Assam and Burma. Calcutta. Ceylon and S. India.)

Zesius chrysomallus Hubner : The Redspot

One netted on 15th March 1963 at Ahwa in the Surat Dangs. Apparently rare.

Tajuria cippus cippus (Fabricius) : The Peacock Royal

From March to November only. Not common. Found on *Poinsettia* blossoms.

Rathinda amor (Fabricius) : The Monkey Puzzle

Found in South Gujarat from September to November. Not common.

(. . . up the Western Ghats to Bombay.)

Deudoryx epijarbas epijarbas (Moore) : The Cornelian

November, December and March. Not common.

Virachola isocrates (Fabricius) : The Common Guava Blue

November to March. Not common.

Virachola perse ghela Fruh. : The Large Guava Blue

Rare. 12 November 1960 on *Poinsettia* blossoms at Ahwa. (Ceylon. S. India.)

Rapala melampus Cramer : The Indian Red Flash

Fairly common from November to April.

PAPILIONIDAE

Polydorus hector (Linnaeus) : The Crimson Rose

Rare in South Gujarat.

(Common in Bengal, S. Bihar, Orissa, S. India.)

Polydorus aristolochiae aristolochiae (Fabricius) : The Common Rose

Common throughout the year.

Chilasa clytia clytia (Linnaeus) : The Common Mime

From July to September. Uncommon and local.

Papilio polymnestor polymnestor Cramer : The Blue Mormon

Uncommon locally from July to October.

(Ceylon. S. India. Madhya Pradesh. S. Bihar. Bengal. Western Ghats to Bombay. Sikkim.)

On 8 July 1960 a large caterpillar of this species was found eating a pumelo leaf (*Citrus grandis*) in the mission school garden at Mulchond. The larva had a greatly enlarged head and was mainly green in colour. It formed a chrysalis on July 10th. The pupa was attached at one end of the base of the leaf stalk on the underside of a pumelo leaf. The male imago emerged on 30 July 1960, hatching in a box in the author's office at Ahwa.

Occasionally this magnificent butterfly measures nearly six inches from wing tip to wing tip.

Papilio helenus daksha Moore : The Red Helen

One netted on 25 October 1957 at Ahwa. Very rare or accidental in Gujarat.

(Ceylon. Western Ghats. Nilgiris. Palnis. Shevaroys. Coorg and Bangalore.)

Papilio polytes Linnaeus : The Common Mormon

The male and its three female forms are found in South Gujarat. The male is very common throughout the year.

♀ form *stichius*—very common throughout the year.
♀ form *romulus*—fairly common throughout the year.
♀ form *cyrus*—very rare.

Papilio demoleus demoleus (Linnaeus) : The Lime Butterfly

Very common throughout the year.

Graphium nomius nomius (Esper) : The Spot Swordtail

Common from February to June; rare in July and August.

Graphium agamemnon agamemnon (Linnaeus) : The Tailed Jay

Very common throughout the year.

Graphium sarpedon teredon Felder : The Common Bluebottle

Rare in September in South Gujarat. More common to the south in the Konkan.

PIERIDAE

Leptosia nina nina (Fabricius) : The Psyche

Some years common from October to March.

Delias eucharis (Drury) : The Common Jezebel

Common throughout the year. Abundant from November to February.

Cepora nerissa (Fabricius) : The Common Gull

Common throughout the year.

Anaphaeis aurota aurota (Fabricius) : The Pioneer

January to May. Not common.

Appias libythea libythea (Fabricius) : The Striped Albatross

Throughout the year. Uncommon.

Appias lyncida latifasciata Moore : The Chocolate Albatross

Throughout the year. Rare.

Appias albina darada Felder : The Common Albatross

January to March. Not common.

Ixias marianne (Cramer) : The White Orange Tip

Fairly common throughout the year.

Ixias pyrene (Linnaeus) : The Yellow Orange Tip

Fairly common throughout the year, but more common in winter.

Colotis calais (Cramer) : The Small Salmon Arab

Rare in the Dangs, but common elsewhere in South Gujarat. ♀ form *albina* at Broach. Uncommon.

Colotis vestalis (Butler) : The White Arab

Rare in the Dangs, but common elsewhere in South Gujarat.

Colotis etrida etrida (Boisduval) : The Little Orange Tip

Uncommon from January to June in the Dangs. Common in Bulsar, Surat, and Broach.

Colotis fausta (Olivier) : The Large Salmon Arab

Rare in the Dangs. Common elsewhere in South Gujarat from October to April.

Colotis eucharis (Fabricius) : The Plain Orange Tip

Rare in the Dangs. Common throughout Broach District and Surat District, especially in winter months.

Colotis danae danae (Fabricius) : The Crimson Tip

Uncommon in the Dangs, but common elsewhere in South Gujarat from October to April.

Hebomoia glaucippe australis Butler : The Great Orange Tip

Only record for the Dangs is in January 1959 at Ahwa. Fairly common in the Konkan south of Gujarat.

Parenonia valeria hippa Fabricius : The Common Wanderer

Fairly common from October to April.

♀ form *philomela* is occasionally found from October to April.

(Recorded from Assam, Calcutta, Jabalpur, the Nilgiris, and N. Kanara.)

Catopsilia crocale (Cramer) : The Common Emigrant

Abundant throughout the year having two distinct female forms, one white and the other yellow.

Catopsilia pomona (Fabricius) : The Lemon Emigrant

Very common throughout the year.

♀ form *catilla* with purple blotches below is fairly common.

Catopsilia pyranthe (Linnaeus) : The Mottled Emigrant

Found throughout the year, but more common during the monsoon.

Catopsilia florella gnoma (Fabricius) : The African Emigrant

Found throughout the year, but more common from October to April.

C. florella may be only the dry season form of *C. pyranthe*; however, this problem needs more study.

Eurema brigitta (Cramer) : The Small Grass Yellow

Common throughout the year.

Eurema laeta Boisduval : The Spotless Grass Yellow

The wet season form *venata* and the dry season form *laeta* are both very common. Wet season form rarely netted at mercury-vapour lamp; however, it is not normally crepuscular nor nocturnal.

Eurema hecabe (Linnaeus) : The Common Grass Yellow

Abundant throughout the year. Occasionally captured at mercury-vapour lamp in Ahwa and sometimes crepuscular.

Eurema blanda silhetana Wall. : The Three-spot Grass Yellow

Uncommon throughout the year.

HESPERIIDAE

Celaenorrhinus leucocera leucocera (Kollar) : The Common Spotted Flat

During the monsoon. Not common.

Celaenorrhinus ambareesa (Moore) : The Malabar Flat

February to May. Not common.

Coladenia dan dan (Fabricius) : The Fulvous Pied Flat

During the monsoon season. Rare.
(S. India. Kulu to Assam and Burma.)

Sarangesa dasahara (Moore) : The Common Small Flat

Fairly common throughout the year.

Sarangesa sati de Nicéville : The Tiny Flat

Common during the monsoon months. According to Wynter-Blyth (p. 464) *S. sati* is now considered a race of *S. purendra*.

Caprona ransonnetti (Felder) : The Golden Angle

Throughout the year, the dry season form much paler than the wet season form. Not common.
(S. India to Igatpuri, Kalka and Assam. Burma. Ceylon.)

Tapena thwaitesi hampsoni El. & Ed. : The Black Angle

Rare in February and March in the Surat Dangs. Not mentioned by Wynter-Blyth, but rare in south India according to Evans.

Spialia galba (Fabricius) : The Indian Skipper

Common throughout the year.

Chromus alexis alexis (Fabricius) (= **Hasora chromus** Cramer, according to some authors) : The Common Banded Awl

Abundant throughout the year. Occasionally attracted to lights at night in the bungalow.

Badamia exclamationis (Fabricius) : The Brown Awl

Fairly common throughout the year.

Suastus gremius (Fabricius) : The Indian Palm Bob

Fairly common in September and October at Waghai, but rare elsewhere.

Arnetta vindhiana (Moore) : The Vindhyan Bob

September and October in the Surat Dangs. Not common.

Matapa aria (Moore) : The Common Redeye

In some years common from September to January; one taken on

16 March 1963. Usually flies early in the morning and at dusk; however, I have netted it at midday on *Lantana* flowers.

(Ceylon. S. India to Matheran and Calcutta. Dun to Assam and Burma.)

Taractrocera ceramas nicevillei Watson : The Tamil Grass Dart

During the monsoon season. Not common.

Telicota ancilla = Astychus augias (Linnaeus), and **A. pythias** (Mabille): The Pale Palm Dart and The Dark Palm Dart

Common from November to May, especially the Dark form.

Potanthus pseudomaesa cato Evans : The Indian Dart

Common from December to March.

Pelopidas conjuncta Hewitson : The Conjoined Swift

December to March. Not common.

Caltoris kumara Moore : The Blank Swift

Fairly common on *Lantana* bushes and in nullahs during October and November.

(Ceylon. Western Ghats to N. Kanara. Palnis, Nilgiris, Bangalore, and High Wavys. Calcutta. Sikkim to Assam and Burma.)

Pelopidas mathias mathias Fabricius : The Small Branded Swift

Common throughout the year.

Borbo bevani Moore : The Bevan's Swift

Fairly common throughout the year.

Udaspes folus Cramer : The Grass Demon

Fairly common throughout the year.

Iambrix salsala (Moore) : The Chestnut Bob

Fairly common from October to March.

(Ceylon. S. India. Sikkim to Calcutta, Assam and Burma.)

SUMMARY

From March 1946 to March 1963 the writer collected thousands of butterflies in the Dangs and the Broach and Surat districts. In all, one hundred and forty-five species and seven additional female forms were collected. Only in a few cases have the dry and wet

season forms been mentioned. Completeness is not claimed in this report, for additional species and races will no doubt be found or may have been overlooked.

Data on the distribution of the butterflies presented in this paper should help to clarify the range of thirty or more species, races, and rare female forms. Many species and races from south India are now extended considerably north of Bombay. From this study it is clear that South Gujarat has a very rich butterfly fauna.

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On the Occurrence of *Thalassina anomala* (Herbst), a burrowing crustacean in Bombay waters, and its burrowing methods

BY

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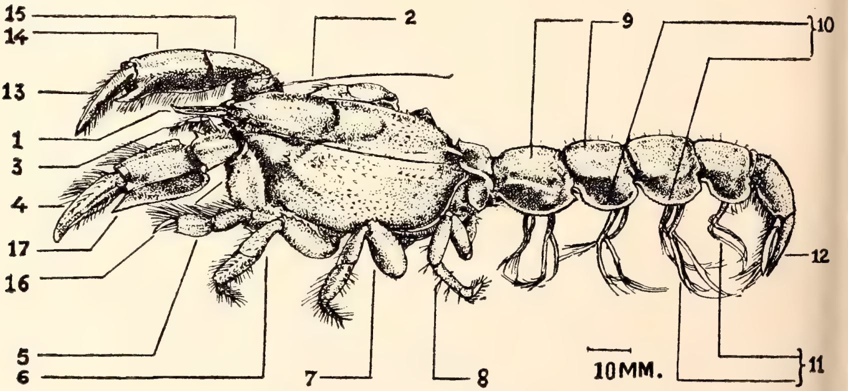
(*With two plates and one text-figure*)

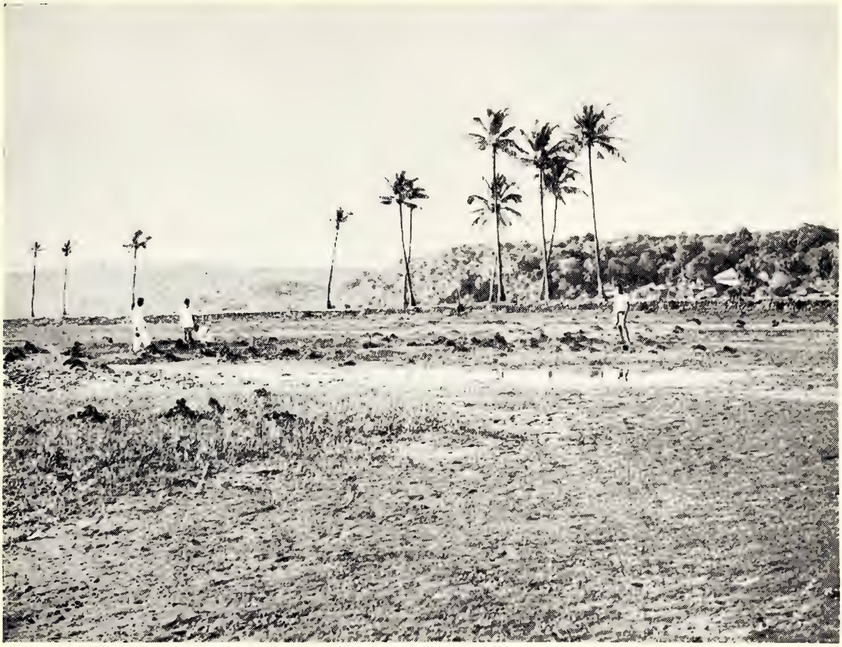
During a shore collection trip along the coast of Ratnagiri, I saw some mounds of mud (Plate I) not far from the low-tide water mark, in the swamps of Karla, a fishing village. These mounds, different from those generally made by crabs, were made by 'scorpion-like' animals according to the villagers. On digging, I found that the 'scorpion-like' animal was *Thalassina anomala* (Herbst) (Text-figure) locally called *angde khod* (*angde* means fingers, and *khod* means to dig, in Marathi). This is the first record of the species from Bombay waters.



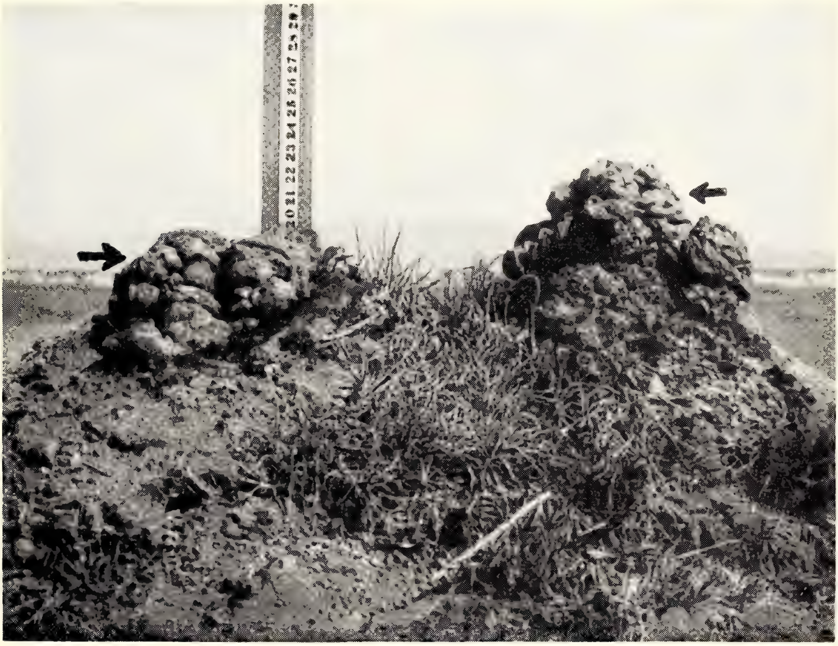
The body parts of *Thalassina anomala* (Herbst) : 1. Antennule ; 2. Antennal flagellum ; 3. Endopodite of third maxilliped ; 4. First leg ; 5. Second leg ; 6. Third leg ; 7. Fourth leg ; 8. Fifth leg ; 9. Abdominal terga ; 10. Abdominal pleurites ; 11. Pleopods ; 12. Telson ; 13. Dactylus ; 14. Propodus ; 15. Carpus ; 16. Merus ; 17. Fixed finger

The genus *Thalassina* is monotypic. de Man (1928) recognizes two varieties, *T. a. gracilis* Dana and *T. a. squamifera* de Man. In India,

Thalassina anomala (Herbst)



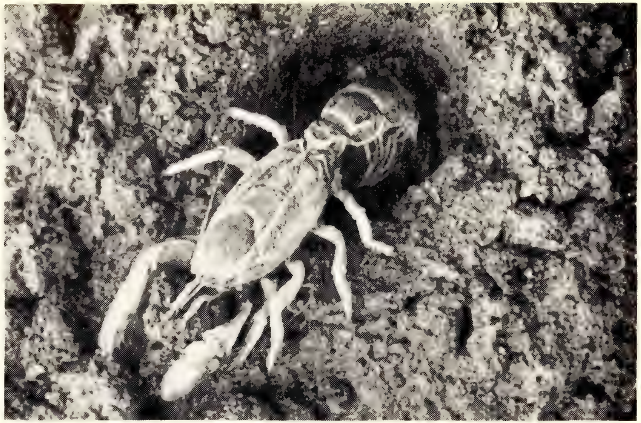
Colonies of mounds near the bund and the houses situated on the edge of the creek



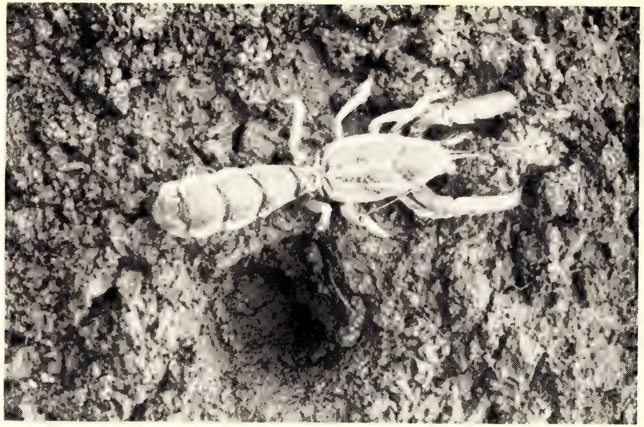
A closer view of the mounds. The arrow indicates the presence of a freshly formed top layer of mud on the entrance of the mound.

Photos : K. N. Sankolli

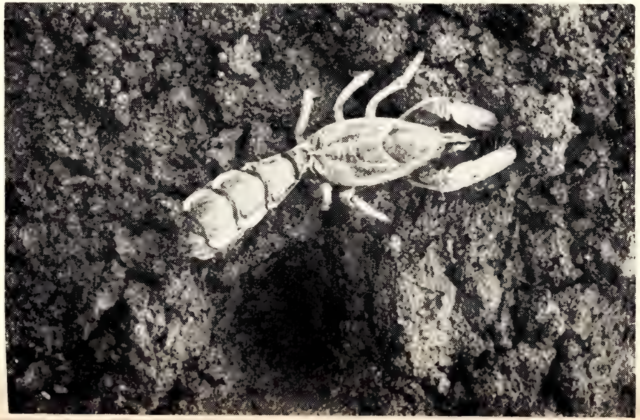
Thalassina anomala (Herbst)



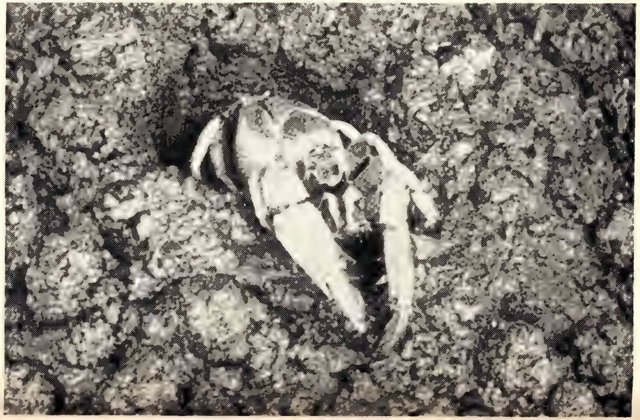
Dorsal view of animal coming out of burrow during the carrying process. The mud is held from above by the third maxillipeds.



Dorsal view showing widening out of first two pairs of legs and bent condition of third maxillipeds during process of dumping.



Dorsal view of animal pushing away excavated mud after



The animal retreating into the burrow.

so far this species has been recorded only from Mysore [Geelvink-bay, as cited by de Man (op. cit.)].

Observations on the habitat and habits of *T. anomala* are few. Pearse (1911) described its burrowing habits and, on the basis of the examination of the stomach-contents of a single specimen, suggested that the animal is vegetarian in diet. According to Marshall & Orr (1960) the species feeds on land vegetation. Johnson (1961) made detailed observations on the food and feeding habits and concluded that *T. anomala* is not a vegetarian, but a mud-feeder. Observations made by me on the feeding habits, mouth parts, and alimentary tract of the animal are more or less similar to those made by Johnson.

The mounds of *T. anomala* range from 1 ft. to 2½ ft. in height, and are so abundant that they form a distinct topographic feature of the mangrove swamps of the Karla creek. The colonies of these mounds often extend beyond the high-tide mark, even into the backyards of the houses on the edges of the creek.

The entrance leading to the main burrow is generally plugged with layers of earth; a freshly formed topmost layer indicates the presence of the animal inside, irrespective of whether this is observed during the day or at night. Burrows dug in the mud flats near low-water mark slope down gradually; those above high-water mark often go almost vertically down until they reach the water level. The main burrow ranges in depth from 4 ft. to 8 ft. and has 6 or 7 side tunnels, of which 3 or 4 may terminate blindly, the blind ends being broader than the tunnels. Several mounds are generally grouped together; in such cases the tunnels of one burrow are often inter-linked with those of the other burrows and make the collection of the animal a difficult task. During a period of one and half years I never came across a specimen outside the burrow, even at night, though I had several reports from local people about the animals having been seen outside the burrows, mostly on moonlit nights.

METHOD OF BURROWING (Plate II)

It is difficult to observe the burrowing of *T. anomala* in its natural habitat, hence the only possibility of recording its behaviour was by allowing it to make burrows in the mud under laboratory conditions.

For this, a wooden tub 2 ft. long, 3 ft. high, and 1¼ ft. broad was filled with soft dark mud to a depth of 2 ft. to 2½ ft. and over it a layer of yellow mud of about 6 in. to 8 in. depth was spread. The two types of mud were collected from the locality where *Thalassina* was abounding. An adequate quantity of water was splashed on to the mud as repeated experience showed that the animal refused to make its burrow when kept on wet mud alone.

When the animal was introduced in the tub, it first crawled for a while. Then, as it came across some soft portion in the mud, it pushed in its second pair of legs inside the soil as if to loosen it. Simultaneously, from the front, the first pair of legs was also introduced in the soil and the digging began. While loosening the soil, nearly the entire propodus together with the whole of the dactylus of the second pair and more than one-half of the propodus of the first pair went inside the mud. The action of the first two pairs of legs while loosening and collecting the mud was like that of a spade in action. During this process, the endopodite of the third maxilliped was also used to a certain extent to manipulate the gathering of the mud in between the first two pairs of chelipeds. The mud was held from either side by the first pair of legs, from below by the second pair held almost in a horizontal plane, and from above by the third maxilliped. After collecting a sufficient load of mud the animal carried the load either forward or backward, in the manner of a tractor, away from its prospective burrow. The way the first two pairs of legs act while holding the mud has been well expressed by Pearse (op. cit.): 'the first two pairs of legs form a sort of basket'. Outside the opening of the newly started burrow, its grip was loosened by widening out the chelipeds—in this process of dumping the mud the endopodite of the third maxilliped played an important role. It was first bent downwards and then moved outwards so as to push the mud away from the burrow. The dumping was also shared by both the chelipeds. Along with the endopodite of the maxilliped, the propodus and dactylus of the chelipeds also moved in an outward direction so that the mud should not fall back into the burrow. After dumping the mud the animal returned to the burrow and recommenced burrowing.

It was interesting to observe the reaction when a small piece of stone was thrown into the burrow while the animal was retreating. It would simply pick up the stone and bring it towards the mouth of the burrow and store it away in the usual manner but, if this was repeated four or five times, the animal would come out farther and push the stone along with the already excavated mud quite far from the previous position. During the digging the animal used to freely bend its abdomen in various postures.

Ecological adaptations. The range of occurrence of the mounds inhabited by these animals is from the low-tide level where they are more or less completely submerged under sea-water, or little above the splash zone of the high tide, where they are subject to dessication. However, the animals living at the higher level, as mentioned earlier, have access to water under the ground through their main burrows.

Of the first two pairs of legs performing the work of excavation and dumping of the mud, the first pair has the major role. Accordingly these two appendages are modified for digging. The fixed finger does not extend beyond half the length of the dactylus; hence it is strengthened and is capable of digging deep in the mud. The inner and outer lateral surfaces of the propodus and dactylus are quite smooth, i.e. without any rough tuberculations, and these two surfaces converge on the ventral margin. The inner lateral surface of the merus is more flattened than that of the carpus. The inward deflexed nature of the fingers, and the smooth and more or less flattened inner lateral surface of the carpus and merus are useful in holding the excavated mud between the chelipeds and in dumping it. The first pair is less hairy than the second, and is so massive and stout that it can bear the weight of the mass of mud which the animal carries during its burrowing operations.

The dactylus, propodus, carpus, and merus of the second leg are flattened from either side. The dactylus is comparatively flat, the flattening being more steep towards the ventral margin. The propodus is produced into a blade-like form and its sub-chelate fixed finger is equally efficient in digging, as it is short and stumpily flat. The ventral surface of the merus is slightly flattened. The ventral margin of the propodus and merus is provided with fringes of bristles. The entire second leg moves in a plane at an angle of less than 90° to the horizontal. Hence, the flattened and fringed nature of its segments offers help in holding and lifting the mass of mud held between the chelipeds and thus provides additional support from below.

The tip of the dactylus of the remaining legs is bent slightly outside, and is provided with some tooth-like spines to have a firm hold on the walls of the burrow during the operations.

The ventral surface of the segments of the endopodite of the third maxilliped is flattened and is fringed with tufted bristles on either side. This facilitates drawing in the mud towards the animal, holding the mud from above during the carrying process, and pushing out the mud, when the grip of both the chelipeds is loosened.

As the abdominal terga are loosely jointed, the animal can easily bend its abdomen beneath the thorax and slightly sidewards, a property of immense importance to a burrowing animal like this thalassinid.

The last three pairs of legs are rather poorly developed, and as such the animal can only crawl sluggishly on land. The pleural plates, because of their lateral extensions, offer protection to the abdomen from its ventral side.

Considering the differences in the range of occurrence of these animals, from low-tide level to far above high-tide level, and the extreme changes in salinity prevailing in the creek during the monsoon and summer, it was found necessary to study the effect of submersion, dessication, and salinity changes, since in nature the animal is exposed to these conditions in the creek.

Under normal conditions of room temperature (25° to 27° C.) the animal, when kept outside the water, could survive for only 14 to 16 hours; when submerged in fresh water or in sea water separately for 15 days, it lived equally well.

The structural peculiarities and tolerance to dessication and extreme changes in salinity indicate that the animal, morphologically and physiologically, is well adapted for its burrowing mode of life in the swamps of the creeks.

The local people are afraid of *T. anomala* because of its grotesque look and its way of spreading out its chelipeds on the slightest disturbance very much like that of a terrestrial scorpion. Also the first pair of chelipeds and the abdomen closely resemble the corresponding parts of a terrestrial scorpion, but there is no poison fang in the terminal segment of its abdomen.

Economic importance. Johnson quotes Dammerman (1929) who states that *T. anomala* is destructive to Nipah seedlings without specifying whether the destruction is caused as the result of feeding activity or other activities of the animal.

I have seen the colonies of *Thalassina* mounds in Karla, Sakhartar, and Mazagaon in Ratnagiri, at Vengurla in the Ratnagiri district, and at Versova and Navha in the Bombay suburban area. The animal is notorious for causing severe damage to bunds by its burrowing activities. The paddy fields and backyards of houses in the proximity of the creeks are also subject to this sort of damage.

ACKNOWLEDGEMENTS

I am greatly indebted to Dr. L. B. Holthuis of Leiden for his guidance in identifying the animal and for sending me a photocopy of the Pearse paper. My grateful thanks to Dr. C. V. Kulkarni for constant encouragement, to Dr. H. G. Kewalramani for his personal guidance, and to Mr. M. R. Ranade for helpful suggestions.

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* Not referred to in original.

Mosses of Eastern India—IV. Eubryiidae

Series II. DICRANALES (Contd.): *Family* LEUCOBRYACEAE, and Series III. POTTIALES: *Family* CALYMPERACEAE[1]

BY

H. C. GANGULEE
Department of Botany, Presidency College, Calcutta

(*With twenty text-figures*)

Series II. DICRANALES (Contd.)

Of the three families representing the series DICRANALES in India, Ditrichaceae (Gangulee 1959) and Dicranaceae (Gangulee 1960) have already been dealt with. The last family Leucobryaceae is taken up here.

The family Leucobryaceae is distinguished from the other two families by the broad costa where one layer of small, green *chlorocyst* cells is sandwiched between two or more layers of large, hyaline *leucocyst* cells. This is a tropical and subtropical family of epiphytes represented in eastern India by 10 species in 5 genera which are enumerated below with their geographical distribution. All these have been examined by the author and are described and illustrated in this paper.

Family LEUCOBRYACEAE

KEY TO THE GENERA

1. Midrib prominent with median stereid strand .. *Leucophanes*
   Midrib not prominent, without stereid 2

2. Chlorocysts in 3 layers: dorsal, ventral, and central; irregularly 3-4-sided. Leaves in several ranks, narrow above from a broad sheathing base, highly papillose. Capsule erect .. .. *Exodictyon*

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[1] The three earlier parts in this series appeared in the *Bull. Bot. Soc. Bengal*:
I. Eubryinales. Series I. Fissidentales. Vol. 11, No. 2, 1957, pp. 59-84;
II. Eubryiidae. Series II. Dicranales. Family Ditrichaceae. Vol. 13, Nos. 1 & 2, 1959, pp. 1-9;
III. Eubryiidae. Series II. Dicranales (contd.). Family Dicranaceae. Vol. 14, 1 & 2, 1960, pp. 10-57.—EDS.

Chlorocysts in a single central layer with 1 or more layers of leucocysts on each side. Hyaline lamina forming a narrow border 3

3. Leaves more or less flat above; chlorocyst cells 3-sided at least in upper half of leaf; capsule erect, symmetrical .. .. *Octoblepharum*

Leaves canaliculate above; chlorocyst cells 4-sided, each at the junction of 4 leucocysts 4

4. Capsule on extended seta, ovoid, inclined, asymmetrical. 16 dicranate peristome teeth .. .. *Leucobryum*

Capsule immersed on short seta, hemispherical. Peristome absent. Leaves smaller .. .. *Ochrobryum*

In the following drawings of the species described, the undermentioned symbols have been used: P_1=natural-sized plant; P_2=magnified plant; P_D=dry plant; L=leaf; L_A=leaf apex; L_B=leaf base; L_{BC}=leaf base cells; $L_{t.s.}$=t.s. of leaf at middle height; $L_{Bt.s.}$=t.s. of leaf base; L_P=perichaetial leaf; Chl=chlorocyst cell; C=capsule; op=operculum; P_T=peristome teeth; S_P=spore.

I. Subfam. LEUCOPHANOIDEAE

LEUCOPHANES Hampe

Whitish green tropical epiphytes with crowded spreading leaves. Stem without central strand. Leaf with a prominent ‘midrib’ because of the presence of a median stereid band. Costa shows one layer of 4-angled chlorocyst cells between 2 layers (there may be more layers near base) of larger leucocyst cells. Leaf bordered throughout by 2 or 3 rows of very narrow, greatly elongated cells. Lamina wings of hyaline cells confined to the leaf base only. Fruiting condition rare. Seta slender, terminal, soon becoming lateral; capsule erect, cylindrical; peristome teeth 16, not cleft or striped, papillose; operculum conic-rostrate; calyptra cucullate with entire base.

1. **Leucophanes octoblepharoides** Bridel in *Bryol. Univ.* **1**: 763, 1826.

Syrrhopodon octoblepharis Nees in *Schwaegr. Suppl.* **4**: t. 311a, 1842.
Octoblepharum octoblepharoides Mitten in Voy. Challenger, Bot. **3**: 259.

Short, glossy, whitish green, epiphytic plants turning brown, densely covered with leaves and forming tufts. Stem without central strand, ±2 cm. long, usually single, sometimes branched. Leaves erect-spreading, linear lanceolate, slightly concave at base and nearly flat above, not much changed when dry, up to 4 mm. long. Wide costa completely covers the whole of the leaf in the upper part, becomes narrower at base (less than ¼ of total leaf length) where only it is flanged by a hyaline lamella; t.s. of costa shows one layer of 4-angled chlorocysts between

2 rows of larger colourless leucocyst cells and a median dorsal stereid band which is prominent as a 'mid-rib'. Leucocysts at leaf base measure ±18×17 μ. Leaf bordered all round with 2 to 3 rows of very long, narrow cells having yellowish, thickened walls. Leaf apex toothed with the percurrent stereid band. Lamina cells hyaline, quadrate to short rectangular, ±24 μ wide. Fruiting plants not seen.

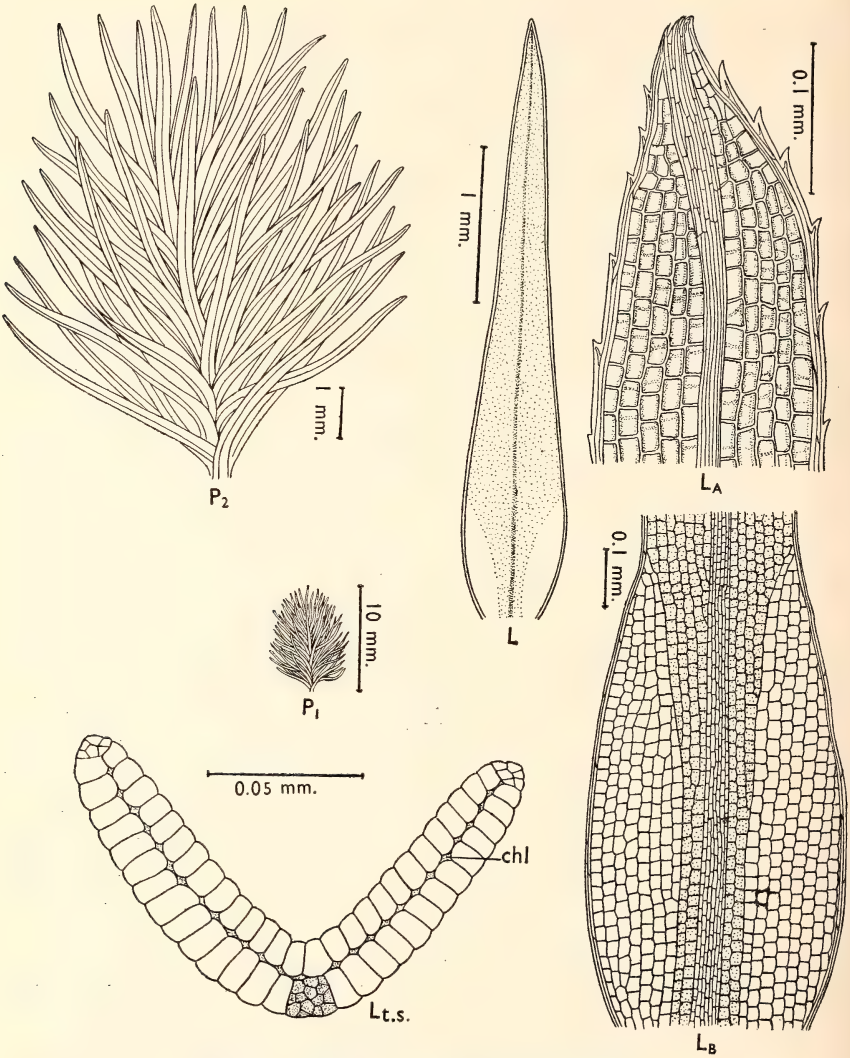

Fig. 69. *Leucophanes octoblepharoides* Bridel

Distribution. Nepal, *Wallich*; NEFA, *Bor* 63; East Bengal, *Brühl, & Sarkar.*

Tropical countries spreading from Nepal eastwards to Pacific Islands.

II. Subfam. LEUCOBRYOIDEAE

LEUCOBRYUM Bridel

General characters as in *Leucophanes* but without any stereid band in costa so that there is no prominent ‘ mid-rib ’.

KEY TO THE SPECIES

1.	Mature vegetative leaves auriculate at base ..	2. *L. sanctum*
	Leaves not auriculate	2
2.	Leaves smooth on back	3
	Leaves strongly scabrous on back	4
3.	Silky plants with slender flexuose leaves up to 10 mm. long. Leaf lamina cells elongated and pitted ..	3. *L. bowringii*
	Coarse plants with shorter leaves (up to 7 mm.). Leaf lamina cells not pitted, elongated only in the border rows	4. *L. nilghiriense*
4.	Large plants with leaves 10 mm. or more in length and more than 1 mm. wide	5. *L. javense*
	Smaller plants with dense leaves less than 3 mm. long and with characteristic pattern on back	5
5.	Leaves broader at tip, chlorocyst cells broader, scabrous cells on back less raised	6. *L. aduncum*
	Leaves narrower and more pointed at tip, chlorocyst cells narrower (± 6 μ wide), scabrous cells on back more prominent	7. *L. scalare*

2. **Leucobryum sanctum** (Brid.) Hampe in *Linnaea* **13** : 42, 1839.

Dicranum glaucum var. *sanctum* Bridel in *Bryol. Univ.* **1** : 811, 1826.
Dicranum sanctum Nees in *Schwaegr. Suppl.* 2 : 121, 1826.
Octoblepharum sanctum Mitt. in *Proc. Roy. Soc.* (1879): 99, 1879.
Leucobryum auriculatum C. Muell. (*fid.* Geheeb) in *Bibl. Bot.* : 2, 1889.

Comparatively robust, brownish pale green epiphytic plants in tufts. Stems up to 3 cm. long, usually branched, without central strand. Leaves erect to erect-spreading, flexuose to secund, not much changed when dry ; abruptly lanceolate-subulate from a ± rectangular base, canaliculate above, shortly apiculate ; mature leaves on vegetative shoots distinctly auriculate, up to 4 mm. long (known to be much longer, up to 7 mm. in Java and Philippine specimens) and about 1 mm. wide at base. Leaves at top and base of vegetative shoots and most leaves on fertile shoots do not show auricles. Wide costa scabrous on back flanged by a narrow lamina only at the basal part. T.s. of leaf shows costa with inner 4-angled chlorocysts sandwiched between 2 layers of leucocysts.

Leucocysts become several-layered on the dorsal side and 2-layered on the ventral side at leaf base near attachment with stem. Leucocyst cells ±48×33 μ at upper part of leaf base becoming smaller towards base and towards margin. Lamina cells hyaline, rectangular, smaller than leucocyst cells, narrower and slightly more elongated at the border. Cells round the auricle smaller and 2-layered. Perichaetial leaves not auriculate, much smaller, ±2 mm. long and 1 mm. broad at base, suddenly tapering from an ovoid base. Terminal, reddish brown seta becomes lateral by further growth, ±1.5 cm. long with an inclined, strongly strumose, more or less sulcate, asymmetrical capsule ±1 mm.

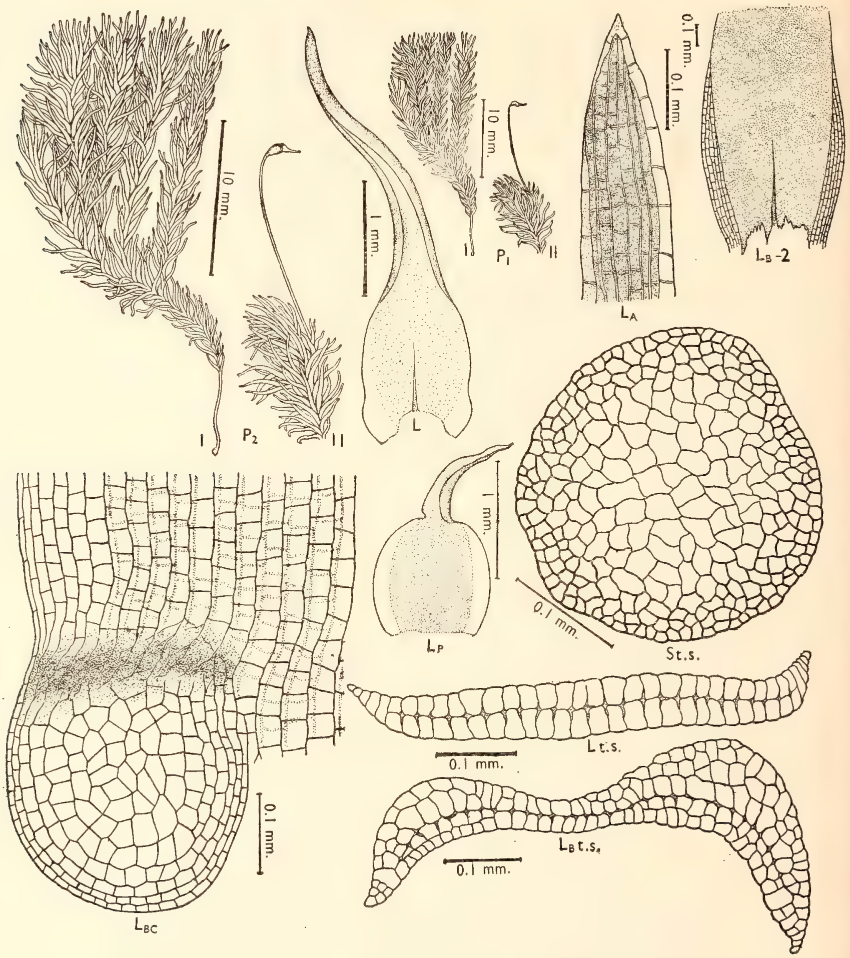

Fig. 70. *Leucobryum sanctum* Hampe

(*Kurz* 2231 and fruiting plant *Griffith* 39 from Moluccas). L_{B_2}-2 = base of a leaf not showing development of auricle. I = sterile plant ; II = fruiting plant.

long and 0.75 mm. in diameter. Peristome teeth 16, dicranate, finely papillose with vertical stripes. Operculum conic-rostrellate, bent to one side. Spores smooth, 10-12 μ in diameter.

Distribution. Nepal, *Wallich* ; Sikkim, *Kurz* 2231.
Malaysia, Java, Borneo, Philippines, New Guinea, Fiji, Samoa.

3. **Leucobryum bowringii** Mitten in *Musc. Ind. Or.* 26, 1859.

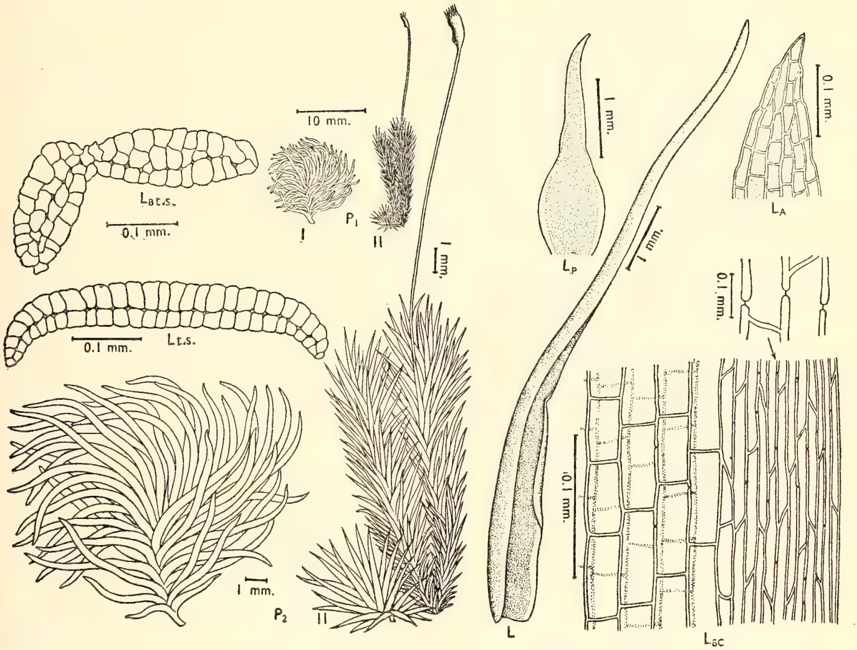

Fig. 71. *Leucobryum bowringii* Mitten
(I. *Gangulee* 757 ; II. Fruiting plant from Japan)

Epiphytic silky plants forming dense tufts with branched stems ±1.5 cm. long and densely covered with narrow elongated leaves. Leaves up to 1 cm. long, patent to flexuose, gradually narrowed to a long, narrow, tubular, acute tip from a wider concave base. Costa wide, smooth at back, showing one layer of 4-angled chlorocysts between 2 layers of leucocysts in the upper part ; leucocysts become multi-layered (2 layers on dorsal side and 1 or 2 layers on the ventral) near the base. Leucocyst cells measure up to 70×28 μ. Lamina cells narrow, elongated, somewhat incrassate with pitted walls, up to 12 rows at the basal region, gradually narrowing and ultimately vanishing upwards. Perichaetial leaves smaller (±3 mm. long) with ovate base. Reddish slender seta ±1.6 cm.

long, lateral by further growth of branches. Capsule inclined, strumose, asymmetrical, ±1.2 mm. long, lightly plicate.

Distribution. Khasia, *J.D.H.* & *T.T.* 1272, 1275 ; *Gangulee* 757 ; NEFA, *Bor* 227.

South India, Ceylon, Malaysia, Borneo, China, Japan, Formosa, Philippines.

4. **Leucobryum nilghiriense** C. Mueller in *Bot. Zeit.* 32: 556, 1854.

L. vulgare Wilson in Hook. *J. Bot. & Kew Gard. Misc.* **9** : 293, 1857.

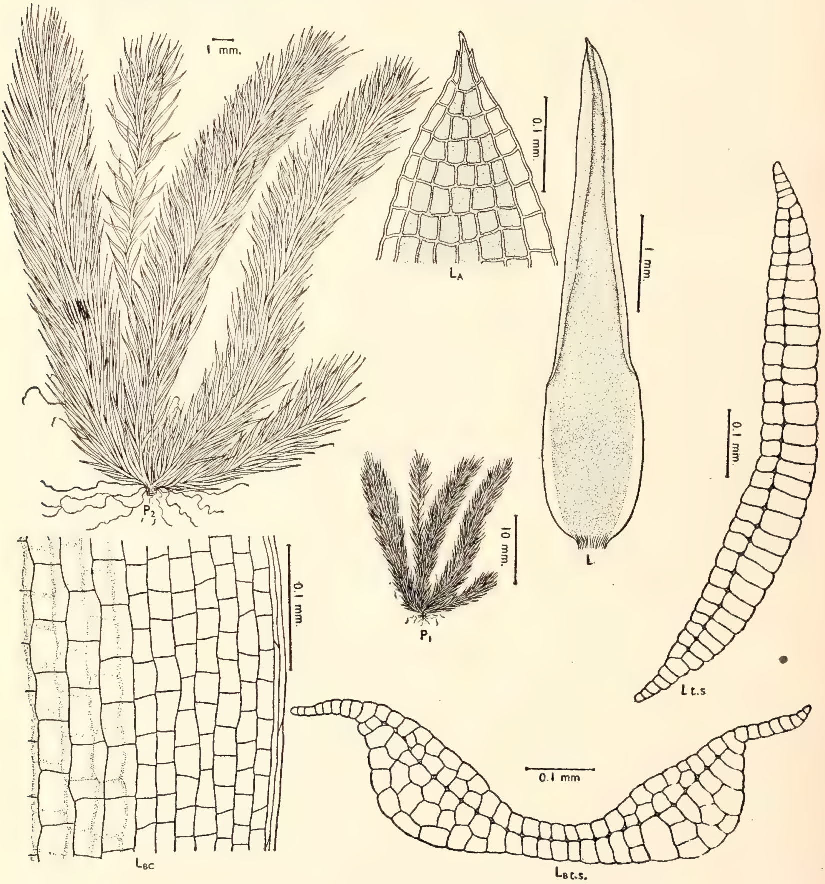

Fig. 72. *Leucobryum nilghiriense* C. Mueller

(*Foreau* 19 from South India)

Dull whitish green plants on tree trunks forming dense tufts with branched or single stems up to 2.5 cm. long densely covered with usually erect, sometimes erect-spreading, more or less rigid leaves up to 6 mm. long. Leaves gradually narrowing from a comparatively broad (±

1 mm. wide), ovate, concave base to a rigid, canaliculate, minutely apiculate apex. Costa wide, smooth on back, with one layer of 4-angled chlorocysts between 2 layers of leucocysts, the latter becoming multi-layered (usually 3 layers on the dorsal and 2 on the ventral side—excepting the median region where the layers do not increase) at the base. Leucocysts ± 42 × 28 μ at leaf base. Lamina cells hyaline, 9 to 12 rows at base, gradually decreasing in width towards top ; inner cells rectangular but 2 or 3 marginal layers at base formed of narrow, elongated cells ; not incrassate or pitted. Fruiting plants not seen.

Distribution. Sikkim, *J.D.H.*; Bhutan, Khasia, *J.D.H. & T.T.* 1277; Manipur, *Deb B*/62.

South India, Ceylon, Sumatra, Java, Celebes, Borneo, Philippines, Tonkin, China, Korea, Japan.

5. **Leucobryum javense** (P. Beauv.) Mitten in *Musc. Ind. Or.* 25, 1859.

Sphagnum javense P. Beauv. in *Prodr.* 88, 1805.
Leucobryum falcatum C. Mueller in *Syn.* **1** : 79, 1848.

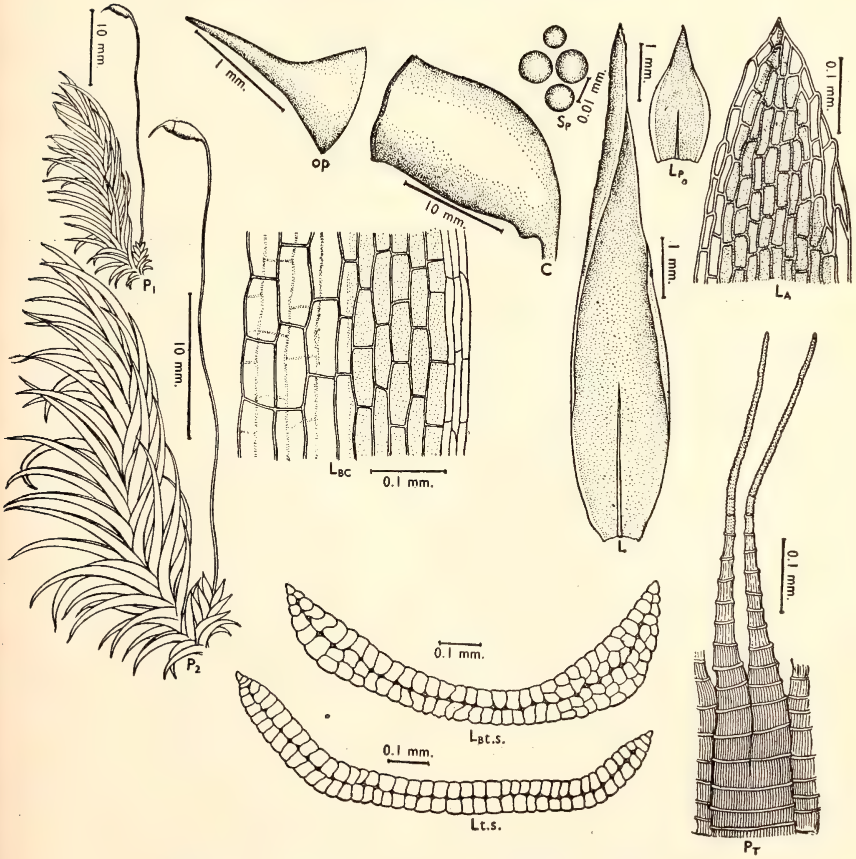

Fig. 73. *Leucobryum javense* (P. Beauv.) Mitten
(*Burkill* 36345)

Comparatively large greenish white plants on tree trunks forming tufts. Stems up to 3 cm. long in these specimens, crowded with falcato-secund leaves up to 10 mm. long and 1.7 mm. broad at base which do not change much when dry. Leaves gradually lanceolate from a broader concave base, tapering into a canaliculate, minutely apiculate point. Costa wide, scabrous on back in the upper half, with one layer of 4-angled chlorocysts between 2 rows of leucocysts except at base where leucocysts on both sides become 2- to 3-layered except at the median furrow. Lamina cells at base formed of 4 to 5 rows of rectangular cells next to costa and with 2 to 3 rows of narrow, elongated cells forming a border; gradually narrowing upwards but persisting up to the tip. Perichaetial leaves much smaller, ± 2.3 mm. long and 1.1 mm. wide at base. Seta red, apical but pushed to a side by growing branches, ±3 cm. long. Capsule short oblong, a symmetrical, almost horizontal, strumose, somewhat sulcate when dry. Peristome teeth red, ± 730 μ long, dicranate to two-thirds of length, vertically striped, papillose at tips. Spores round, smooth, brown, 10 to 15 μ in diameter. Calyptra conic-rostrate, bent to one side.

Distribution. Nepal, *J.D.H.* 1270, 1271 ; Sikkim, NEFA, *Burkill* 36345 ; Khasia, *J.D.H. & T.T.* 1276 ; Naga Hills, *Bor* 363.

NW. Himalayas, south India, Ceylon, Malaysia, Yunnan, Hong Kong, Java, Borneo, Philippines, New Guinea.

6. **Leucobryum aduncum** Dozy et Molkenboer in *Bryol. Jav.* **1** : 13, 1855-61.

L. brachyphyllum Wilson in Hook. *J. Bot. & Kew Gard. Misc.* **9**: 293, 1857.

Greenish brown plants on tree trunks forming tufts. Stem without central cylinder, branched, up to 2.5 cm. long, densely covered with leaves. Leaves erect, up to 3 mm. long, iridescent and somewhat falcato-secund when dry, narrowed from an oval concave base (up to 0.7 mm. broad) into a short, canaliculate tip. Costa wide, prominently scabrous on back showing a distinct pattern, with one layer of 4-angled chlorocysts between 2 layers of leucocysts which later become 4-layered (2 layers on each side) at leaf base. A narrow lamina of 3 to 4 rows of hyalocysts at base which become narrower but still persist in the upper part. Leucocyst cells at base up to 67 × 20 μ ; lamina cells also rectangular but smaller, becoming narrow and rhomboid at the margin, not incrassate. Fruiting plants not seen.

Distribution. Nepal, *Hooker*, *Gollan* 2115.

South India, Malaysia, Java, Borneo.

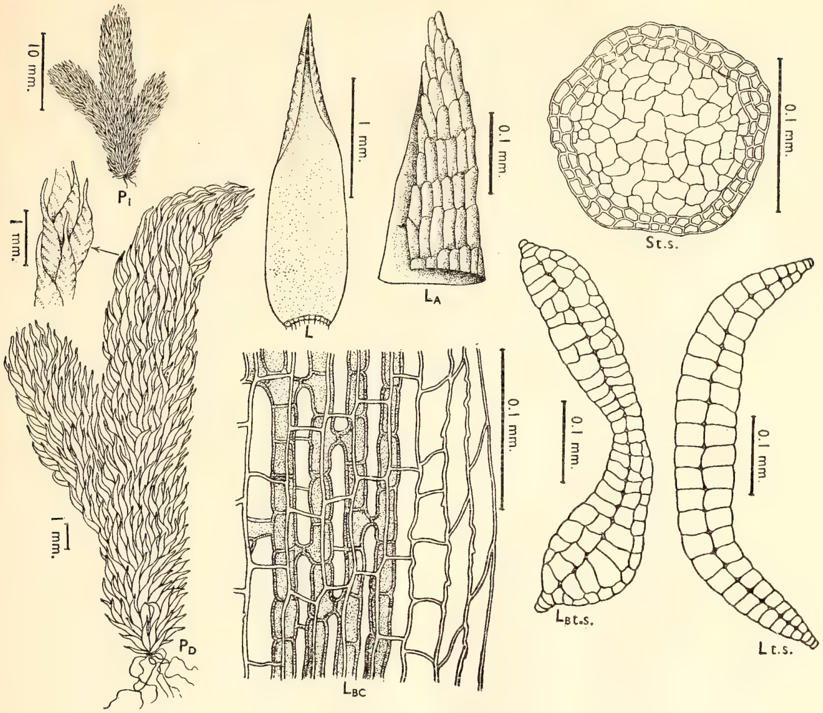

Fig. 74. *Leucobryum aduncum* Dozy et Molkenboer (*Gollan* 2115). P (inset) and L_A show pattern on leaf back due to scabrous nature.

7. **Leucobryu scalare** C. Mueller in Micholitz, *Musci Philipp.* No. 173 & Paris, *Index Bryol. Suppl.* 230, 1900.

Light yellow-green plants on tree trunks forming dense tufts. Stem usually with several branches, densely covered with leaves, up to 2 cm. long. Leaves more or less bent to one side (sometimes erect), more strongly so when dry ; up to 2.45 mm. long and 0.74 mm. wide at middle ; leaf base elongated, elliptical, suddenly narrowed from middle to a canaliculate tip which is more pointed than in *L. aduncum*. Narrow transparent lamina on both sides become narrower towards base and apex, shows 5 to 6 rows in the middle of the leaf of which the outermost 2 to 3 layers are of long (± 159 μ), narrow prosenchymatous cells with perforated walls, while the inner 2 to 3 layers are rectangular (up to 35 × 20 μ) with irregularly thickened walls. All the inner part of the leaf is formed of the broad costa with two layers of leucocysts (cells ± 44 × 29 μ) sandwiching one layer of narrow, chlorocyst cells as in *L. aduncum* but narrower (± 6 μ wide) in this case. Leaf base shows more layers of such leucocysts. Costa back prominently scabrous with the cells on back much more raised than in *L. aduncum* so that the leaf tip looks toothed.

Fruiting plant not known.

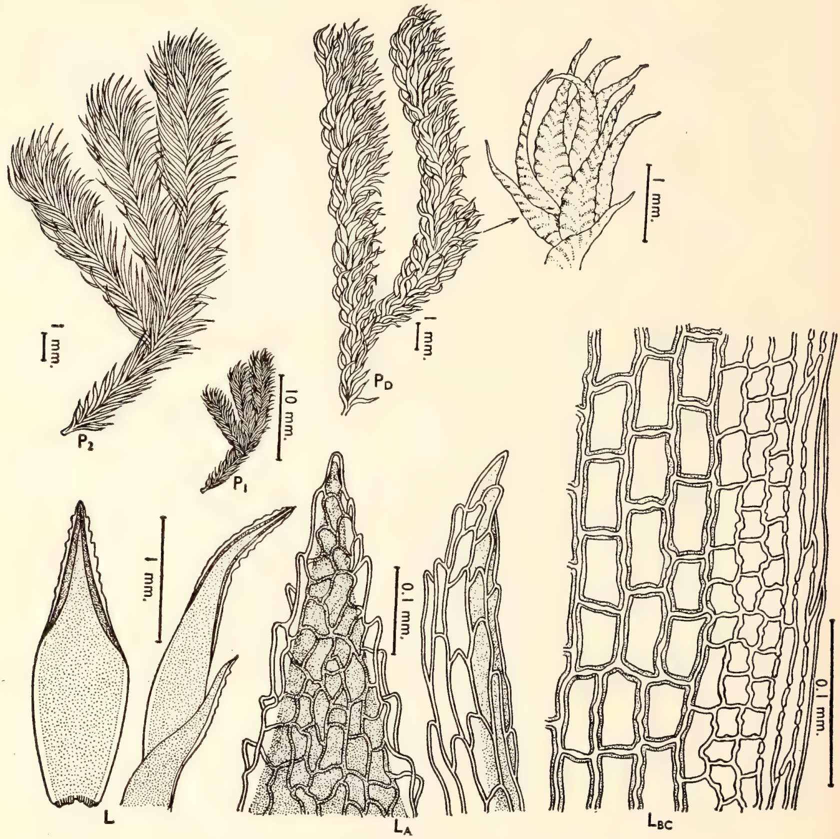

Fig. 75. *Leucobryum scalare* C. Mueller

(Foreau from Palni Hills). P_D (inset) shows scabrous pattern on dry leaf back and L_A shows the elevated cells on back.

Distribution. Manipur, *Deb B*/109.

South India, Malacca, Singapore, Java, Borneo, Philippines, New Caledonia.

OCHROBRYUM Mitten

Dioicous, whitish green, tufted plants with stems devoid of central strand. Leaves erect, formed mainly of a broad multi-layered costa showing one layer of chlorocyst cells (4-angled as in *Leucobryum*) between two layers of leucocysts, bordered by a hyaline lamina. Seta apical, very short with an immersed, erect, hemispherical capsule. Peristome absent. Calyptra frilled at base.

8. **Ochrobryum nepalense** Bescherelle in *J. de Bot.* **11** : 144, 1897.

Schistomitrium gardnerianum Mitten p. p. in *Musc. Ind. Or.* 26, 1859.

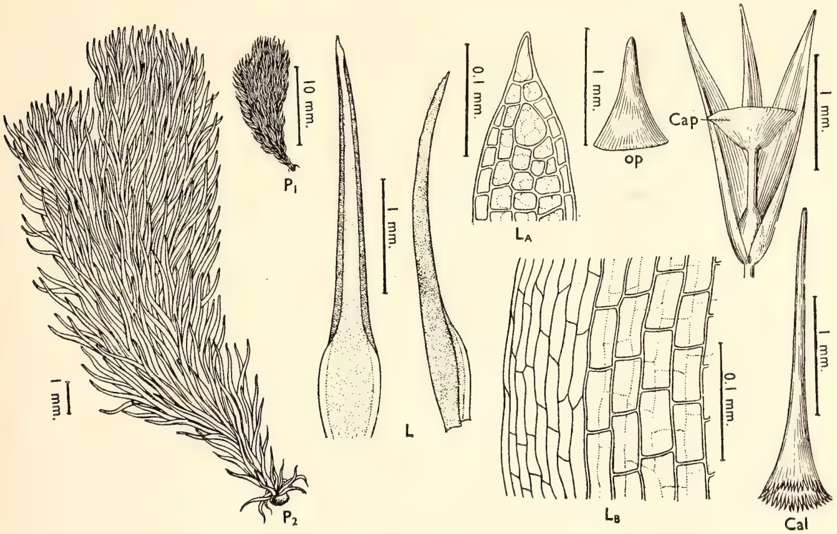

Fig. 76. *Ochrobryum nepalense* Bescherelle
(Poilane from Cambodia). Capsule, operculum and calyptra from Bescherelle's figures after Wilson

Caespitose erect plants, simple or branched, up to 2 cm. long and 0.5 cm. wide with leaves, densely covered with whitish green, imbricate, erecto-patent (not much changed but more appressed when dry) leaves. Leaves up to 3.75 mm. long, with a broad, ovate, sheathing, concave, ± 0.4 mm. wide base which is about $\frac{1}{4}$ of the total leaf length ; narrowing into a lanceolate upper part with inflexed, concave margin becoming almost tubular at tip ; apex narrow with a small apiculus. A hyaline lamina of thin-walled (sometimes porose), elongated, rectangular cells (± 70 μ long) extends on both sides of costa from base to at least the middle of the leaf, 7 to 8 rows of these cells are seen at the leaf base. Costa flat, brownish green, occupying most of the leaf at base and all of it at the tip with two layers of leucocyst cells (up to 56×23 μ) at leaf base. These cells are smaller at leaf apex. Perichaetial leaves shorter. Seta very short (± 1 mm. long), apical, erect, reddish at base, with a stout vaginula. Capsule immersed, hemispherical, cup-shaped, without peristome. Operculum conic-rostrate. Calyptra narrow, very much elongated, base fimbriate.

Differs from *O. kurzianum* in the shorter operculum and from other species in the narrow leaf apex.

Distribution. Nepal, *Wallich.*
Cambodia.

Subfam. OCTOBLEPHAROIDEAE

OCTOBLEPHARUM Hedwig

Autoicous, greenish white, tufted, epiphytic plants with stem devoid of central strand. Leaves formed mainly of a broad, thick (multi-layered) costa formed of one layer of chlorocyst cells (3-angled, at least in upper parts) between several layers of leucocysts ; bordered with a narrow, hyaline lamina only at base. Capsule erect, symmetrical. Peristome teeth 8 or 16 (8 pairs). Calyptra cucullate, entire at base.

9. **Octoblepharum albidum** Hedwig in *Sp. Musc.* 50, 1801.
Bryum albidum Linn. Sp. Pl. 1583, 1762-1763.

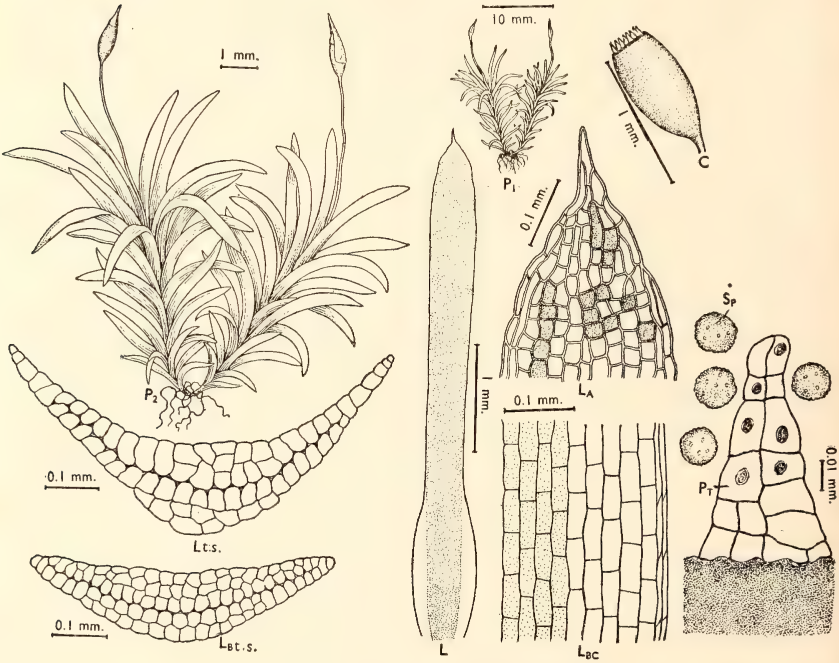

Fig. 77. *Octoblepharum albidum* Hedwig
(*Gangulee* 3004)

Autoicous, greenish white plants up to 2 cm. high, forming tufts on tree trunks. Stem usually only 5 mm. and not branched but may be longer, without central strand. Leaves more or less crowded, erect-spreading, rigid, not changed when dry, usually forming a rosette near tip, ± 5 mm. long, ligulate from a wider and concave ± sheathing base, more or less flat above, apiculate at tip where it may be minutely serrulate. Costa wide, smooth on back, with a median row of triangular chlorocyst cells between 5 to 6 layers of leucocysts in the middle of the leaf and 2 such layers on the sides. Leaf base flanked by 5 to 9 rows of hyaline laminar cells of which inner rows are rectangular (about 30 μ wide) like the leucocyst cells and the border 2 rows are narrow linear to rhomboidal. The outer linear rows persist to the tip of the leaf. Seta straight, apical, ± 5 mm. long. Capsule erect, oblong-ovoid, symmetrical ; urn ± 0.8 mm. long × 0.45 mm. in diameter ; 8 yellowish peristome teeth, not split but showing longitudinal line of fissure, each 110 μ long and 67 μ wide at base, formed of short rectangular cells. Operculum conical, $\frac{1}{2}$ to $\frac{2}{3}$ of urn in height. Calyptra cucullate, entire at base, reaching about two-thirds down the urn. Spores light brown, finely papillose, 19.5 to 21 μ in diameter. Fruiting in October.

Distribution. Nepal, *Wallich*, *Jap. Expdn.* 65721 ; Sikkim, *Hooker* 1280, *Gammie* 24, *Dr. King* ; West Bengal Himalayas, *Kurz* 2479, *Gangulee* 741, 3004 ; Lower Bengal, *Gangulee* 3079, 3096 ; NEFA, *Burkill* 37027, *Bor* 154 ; Manipur, *Deb B*/125.

Cosmopolitan all over the tropics.

Subfam. ARTHOCORMOIDEAE

EXODICTYON Cardot

Dioicous, tufted whitish green plants with stems devoid of central strand. Leaves narrow from a broader sheathing base, spread out in several rows, formed mainly of thick costa rounded at back, triangular at apex, usually papillose showing three layers (dorsal, ventral, and median) of chlorocysts and several layers of leucocysts in between; bordered by a hyaline lamina which is very narrow above. Seta slender, capsule erect cylindrical. Peristome of 16 undivided papillose teeth. Calyptra cucullate, entire at base.

10. **Exodictyon blumii** (C. Muell.) Fleisch. in *Musci Archi. Indici* No. 58, 1899.

Leucophanes blumii C. Muell. in Syn. **2** : 537, 1851.

Branched or unbranched whitish green plants in loose tufts. Stems greenish, 1 to 3 cm. long and up to 0.7 mm. wide with the evenly spread and feathery (but in several ranks) erecto-patent leaves which are not much changed when dry. Leaves up to 3.6 mm. long, linear from an erect, concave, sheathing, elongated-oval base (about $\frac{1}{3}$ of leaf length), ± 0.33 mm. wide ; leaf margin serrulate, spinously serrate at leaf shoulder ; leaf apex blunt, often showing filamentous gemmae (± 165 μ long) on the tip. Leaf bordered from base to apex by 2 to 4 rows of very elongated, narrow, incrassate cells ; the teeth, where present, are outside this border—these cells are wider at the leaf shoulder while the lumens are almost non-existing near the tip. Brownish green costa narrow (± 66 μ broad) at base, spinose on both surfaces and shows three layers of 3-to 4-angled chlorocysts with hyaline cells in between in cross section. Hyaline lamina cells 6 to 8 rows (± 33 × 10 μ) at base ; somewhat wider (± 16.5 μ wide) at the shoulder, smaller (± 24.5 × 9.5 μ) and gradually reduced to only one row near tip. Seta red-brown, erect, ± 4 μ long.

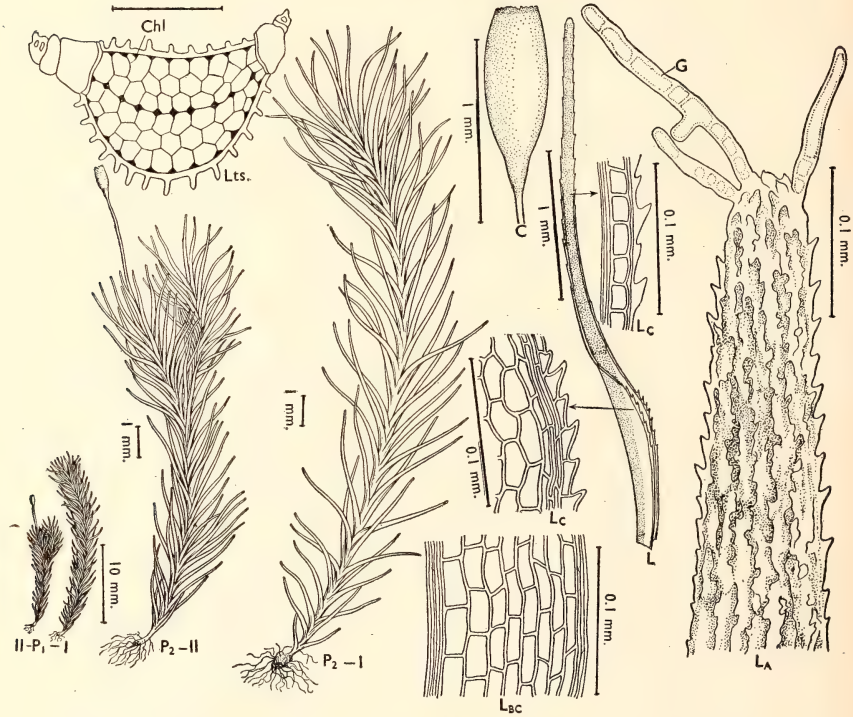

Fig. 78. *Exodictyon blumii* Bescherelle

Sterile plant from Type (*Fleischer* 58 from Java). Fertile plant *Everett* from East Indies

Erect, ovate, red-brown capsule ± 0.8 mm. long and 0.3 mm. in diameter with a distinct apophysis 0.2 mm. long.

The external and internal appearance of the costa is a distinctive feature.

Distribution. NEFA, *Bor* 21*b*.
China, Malay, Java, Borneo, Celebes, Philippines, Oceania.

Series III. POTTIALES

Family CALYMPERACEAE

The third series POTTIALES in PFLANZENFAMILIEN (Brotherus 1924) is represented by the families Calymperaceae and Pottiaceae in eastern India.

The family Calymperaceae is identified by the large hyaline cells in the inner leaf base forming the ' cancellinae '. Capsules are erect. Peristome missing or with 16 teeth. Calyptra completely covering capsule. The family is represented in eastern India by 10 species in 3 genera which are enumerated below. All these (including one new species) have been examined by the author and are fully dealt with here.

Family CALYMPERACEAE

KEY TO THE GENERA

1. Leaves with a hyaline border, peristome present .. 2
   Leaves without hyaline border, peristome absent .. *Calymperes*
2. Hyaline border narrow, seta terminal .. .. *Syrrhopodon*
   Hyaline border broad, seta terminal on side branches *Thyridium*

In the following drawings, in addition to those used in the previous family, the following symbols have been used: G=gemmae; L_G=leaf bearing gemmae ; cal=calyptra.

SYRRHOPODON Schwaeg.

Small to medium-sized epiphytes with more or less erect main stems. Leaves linear-lanceolate to lingulate from an erect sheathing pale base, usually with a narrow, hyaline or thickened border. Upper leaf cells small, papillose ; inner basal cells large, hyaline, forming *cancellinae.* Perichaetia not differentiated. Capsule erect, cylindrical. Peristome of 16 papillose teeth. Calyptra cucullate.

KEY TO THE SPECIES

Cancellinae extending to above midleaf .. .. 1. *S. rufescens*
Cancellinae confined to leaf base .. .. .. 2. *S. gardneri*

1. **Syrrhopodon rufescens** Hooker et Greville in Brewster, *Edinb. J. Sci.* **3** : 227, 1824.

Leucophanella rufescens (Hook. et Grev.) Fleischer in *Musc. Flor. Buitnz.* **1** : 200, 1902.

S. revolutus Dozy et Molkenboer fide Mitten in *Musci Ind. Or.* 39, 1859 but considered different by subsequent authors.

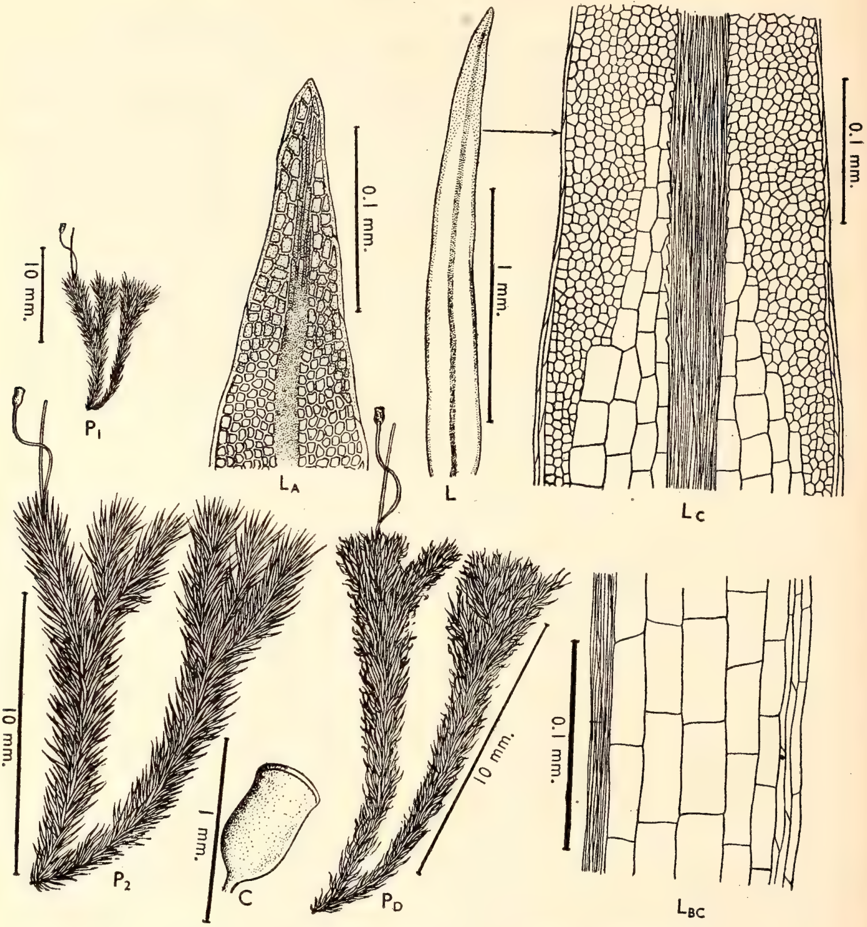

Fig. 79. *Syrrhopodon rufescens* Hooker et Greville
Wallich from Nepal

Subgenus *Orthophyllum* C. Mueller=Section *Leucophanella* Bescherelle=Genus *Leucophanella* Fleischer. Dioicous, glossy, greenish brown, dichotomously branched (stem up to 1.5 cm. long) plants with a reddish (rufescent) tint and white leaf bases forming epiphytic tufts and densely covered with erect leaves whose tips become flexuose and contorted when dry. Leaves up to 2 mm. long and 0.22 mm. wide at base, narrow lanceolate, gradually acuminate from the hyaline base, carinate-concave ; bordered all round with 3 to 1 row of elongated, narrow, hyaline cells ; margin ± flat and entire. Costa without deuter, rough at top of cancellinae, narrow, percurrent. Cancellinae of large (up to $60 \times 28\ \mu$), rectangular, hyaline cells reaching very near tip covering more than $\frac{3}{4}$ of leaf length. Chlorophyllose cells at tip subquadrate, incrassate, papillose. Seta terminal, very slender, 6 to 7 mm. long, usually straight, sometimes sinuous. Capsule erect, small, oval, ±0.65 mm. long and 0.36 mm. in diameter. Fruiting about February.

Distribution. Nepal, *Wallich.*
Malay, Indian Archipelago, Java, Philippines.

2. **Syrrhopodon gardneri** (Hooker) Schwaeg. in *Suppl.* **2** (2) : 110, 1826.

Calymperes gardneri Hooker in *Musc. Exot. Pl.* 146, 1818.
Syrrhopodon curranii Brotherus in *Philip. J. Sci.* **C5** : 142, 1910.
Cleisostoma gardneri Bridel in *Bryol. Univ.* **1** : 155, 1826.
Weisia macclellandi Griffith in Not. 408, 1849, and *Icon. Plant. Asiat.* **2** : t. 78, 1849.

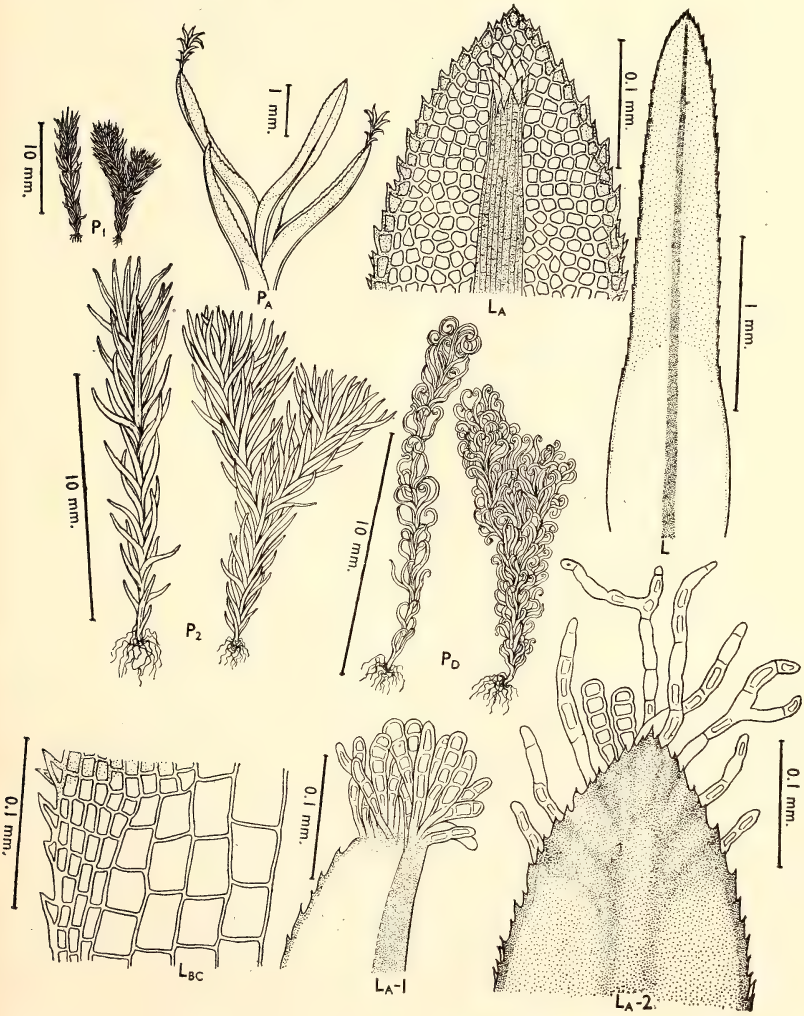

Fig. 80. *Syrrhopodon gardneri* (Hooker) Schwaeg.

(*Gangulee* 2480). P_A = plant apex with sprouting plants on leaf-tips ; L_A-1 = gemmae on leaf-tip ; L_A-2 = protonema-like germination of such gemmae. L_{BC} shows top of cancellinae and leaf margin. Papillae not shown.

Subgenus *Orthotheca* Bridel, Section *Paracalymperes* Fleischer. Dioicous. Tufted, dull green, epiphytic plants with usually single, sometimes dichotomously branched stems without any central strand and up to 1.3 cm. high. Leaves rigidly erect spreading from a slightly wider sheathing base into a ligulate, carinate lamina; up to 3.5 mm. long and 0.7 mm. broad at base; tip acute. Leaf margin sharply serrate from slightly above base to apex. Leaf-edge with a triangularly thickened, double-toothed border from top of base to a little below tip but the border cells are similar to lamina cells. Cancellinae of about 8 to 10 rows of hyaline rectangular cells on each side of costa filling most of the leaf base, except a narrow border of 3-6 rows of smaller hyaline cells, to a height of about ⅓ the leaf length with a rounded acute-angled top. Chlorophyllose lamina cells quadrate to ovate, ± 8.5 μ in diameter, slightly elongated (± 11 μ in diameter) below, papillose and obscure. Costa narrow, with deuter cells in cross section, ending in a number of spines slightly below apex. Fruiting plants not seen. Specimen 2480 from Darjeeling copious development of elongated gemmae from leaf-tip. These gemmae also show protonema-like growth *in situ* and young plants are seen to develop on leaf-tips.

Distribution. Nepal, *Gardner, Wallich*; Bengal Himalayas, *Gangulee* 2480, 4965; Bhutan; Khasiya, *J.D.H. & T.T.* 124.

NW. Himalayas, Ceylon, Siam, Java, Borneo, Philippines.

THYRIDIUM Mitten

Main stem creeping with erect shoots. Leaves oblong or lingulate from an erect, sheathing, hyaline base. Hyaline border of elongated cells broad and extending above middle of leaf; upper lamina cells small, incrassate, papillose, distinct from border and the hyaline cancellinae at leaf base. Seta terminal on lateral branches. Peristome teeth papillose. Calyptra cucullate.

KEY TO THE SPECIES

Fasciculated plants more than 1 cm. high	3. *T. fasciculatum*
Shorter plants less than 1 cm. high	4. *T. piluliferum*

3. **Thyridium fasciculatum** (Hooker et Greville) Mitten in *J. Linn. Soc.* **11**: 189, 1869.

Syrrhopodon fasciculatus Hook. et Grev. in Brewster, *Edinb. J. Sci.* **3**: 225, 1824.

Codontoblepharon fasciculatum Dozy et Molkenboer in *Bryol. Jav.* **1**: 53, 1856.

Calymperes fasciculatum Mitten (*non* Dozy et Molk.) in *Musc. Ind. Or.* 41, 1859.

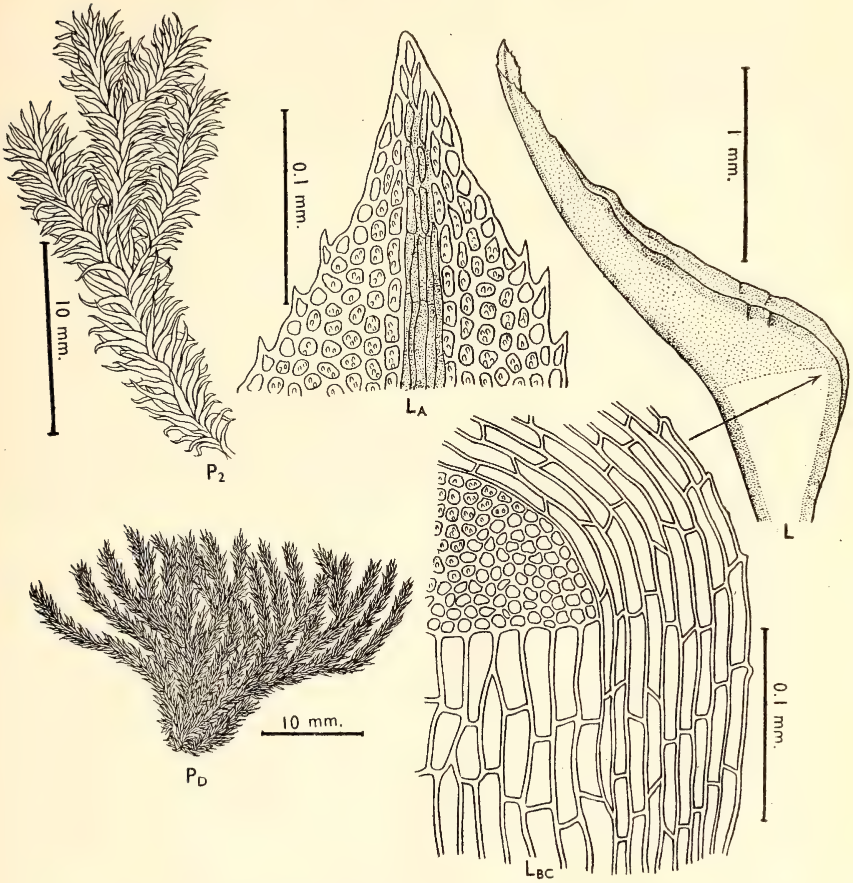

Fig. 81. *Thyridium fasciculatum* (Hooker et Greville) Mitten
Wallich from Nepal

Dioicous. Epiphytic, more or less robust plants in fascicles. Shoots up to 2 cm. long. Leaves erecto-patent, ± 3 mm. long and 1.5 mm. broad in the widest region ; canaliculate and slowly tapering from a wide, sheathing, concave base ; tip acute and somewhat flexuose when dry ; margin undulate but almost flat. A wide border (± 90μ broad at leaf base) of about 9 rows of elongated (± 56 × 10 μ at base), hyaline cells is prominent. It narrows gradually and vanishes quite near leaf-tip. Triangular cancellinae of about 24 rows of hyaline, elongated cells, longer ones up to 56 × 17 μ, ± 0.75 mm. high and 0.55 mm. wide at top on each side of costa. Chlorophyllose cells small, oval to subquadrate, incrassate, multipapillate, ± 5 μ wide. Leaf margin denticulate at sheath, serrate near tip. Costa narrow, percurrent, rough on back near tip. Fruiting plants not seen.

Distribution. Nepal, *Wallich.*

South India, Ceylon, Malacca, Indian Archipelago, Java, New Guinea, Australia, Samoa, Chili.

4. **Thyridium piluliferum** (Dixon) Gangulee, comb. nov.

Syrrhopodon pilulifer Dixon in *J. Bombay nat. Hist. Soc.* **39** : 769-795, 1937.

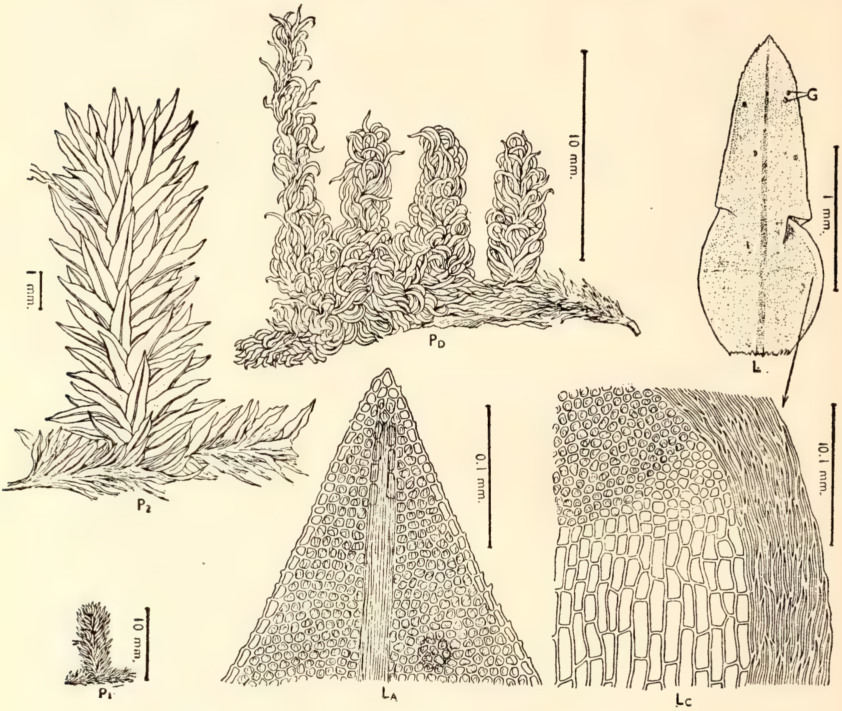

Fig. 82. *Thyridium piluliferum* (Dixon) Gangulee (*Bor* 46—Type). G shows gemmae

Corticolous olive-green plants ramifying on bark giving rise to erect shoots 3 to 7 mm. high and ± 4 mm. wide with leaves. Dense erecto-spreading leaves, oblong lanceolate, up to 2.5 mm. long and 0.87 mm. wide at the wider base; margin wavy, almost smooth, apex acute, minutely denticulate. Dry leaves curled or falcate. Costa brownish at base, yellowish above, smooth, ± 55 μ wide at top of cancellinae. Broad margin ± 60 μ wide at top of cancellinae showing 14 to 16 rows of narrow, elongated, incrassate, cartilaginous cells, ± 45 μ long; this broad border spreads from base to a little below tip, narrowing at both ends. Transparent cancellinae horizontal on top, ± 550 μ high, formed of large, thin-walled rectangular cells up to ±45×12 μ. Chlorophyllose cells above small (± 5 μ wide), oval to subquadrate, somewhat incrassate, papillose though not obscure. Spherical multicellular gemmae 20 to

30 μ in diameter on upper leaf surface, specially on the upper half. Small fusiform apical gemmae as well as filamentous growth noticed on tips of some mature leaves.

Fruiting plant not seen. Dixon reports seta ± 5 mm. long and minute, erect to nodding capsule.

Distribution. NEFA, *Bor* 46.

CALYMPERES Swartz

Epiphytic plants forming tufts. Leaves lanceolate or ligulate, curled when dry. Costa stout, usually gemmiferous in the tips of upper leaves which are longer and narrower than the lower. Chlorophyllose lamellar cells small. Border usually thicker and often with submarginal elongated cells forming tenioli. Cancellinae of lax, hyaline cells prominent in leaf base. Seta and capsule erect. Peristome absent. Calyptra large, covering complete capsule, pleated, often scabrous on top, usually persistent.

KEY TO THE SPECIES

1.	Sturdy plants ± 3 cm. high	10. *C. heterophyllum*
	Slender plants usually up to 1.5 cm. high	**2**
2.	Tenioli not developed on lamina	5. *C. tenerum*
	Tenioli prominent on lamina	**3**
3.	Cancellinae top scalariform, dry leaves falcate inflexed..	6. *C. burmense*
	Cancellinae top rounded or rectangular, dry leaves curled	**4**
4.	Base of normal leaf rounded oval, broader than lamina; apex broadly pointed or rounded	7. *C. hampei*
	Base of normal leaf rectangular, as wide as lamina ; apex rounded	8. *C. calcuttense*
	Base of normal leaf narrower than lamina ; apex rounded	9. *C. noakhalensis*

5. **Calymperes tenerum** C. Mueller in *Linnaea* **37** : 174, 1871.

C. dozyanum Bescherelle (*non* Mitt.) in *Ann. Sci. Nat. Bot.*, Ser. 8,1: 264 & 283, 1896.

Subgenus *Hyophilina.* Section *Stenocycla.* Dioicous. Plants forming tufts of green epiphytic plants with stiff leaves which soften on getting wet. Plants usually short with rosette-like spreading of leaves on top ; stem simple, may be up to 6.5 mm. long with erect leaves ± 2.5 mm. long and 0.5 mm. broad which are curled and incurved when dry. Normal leaves lingulate, base not broader than lamina, apex obtuse. Upper

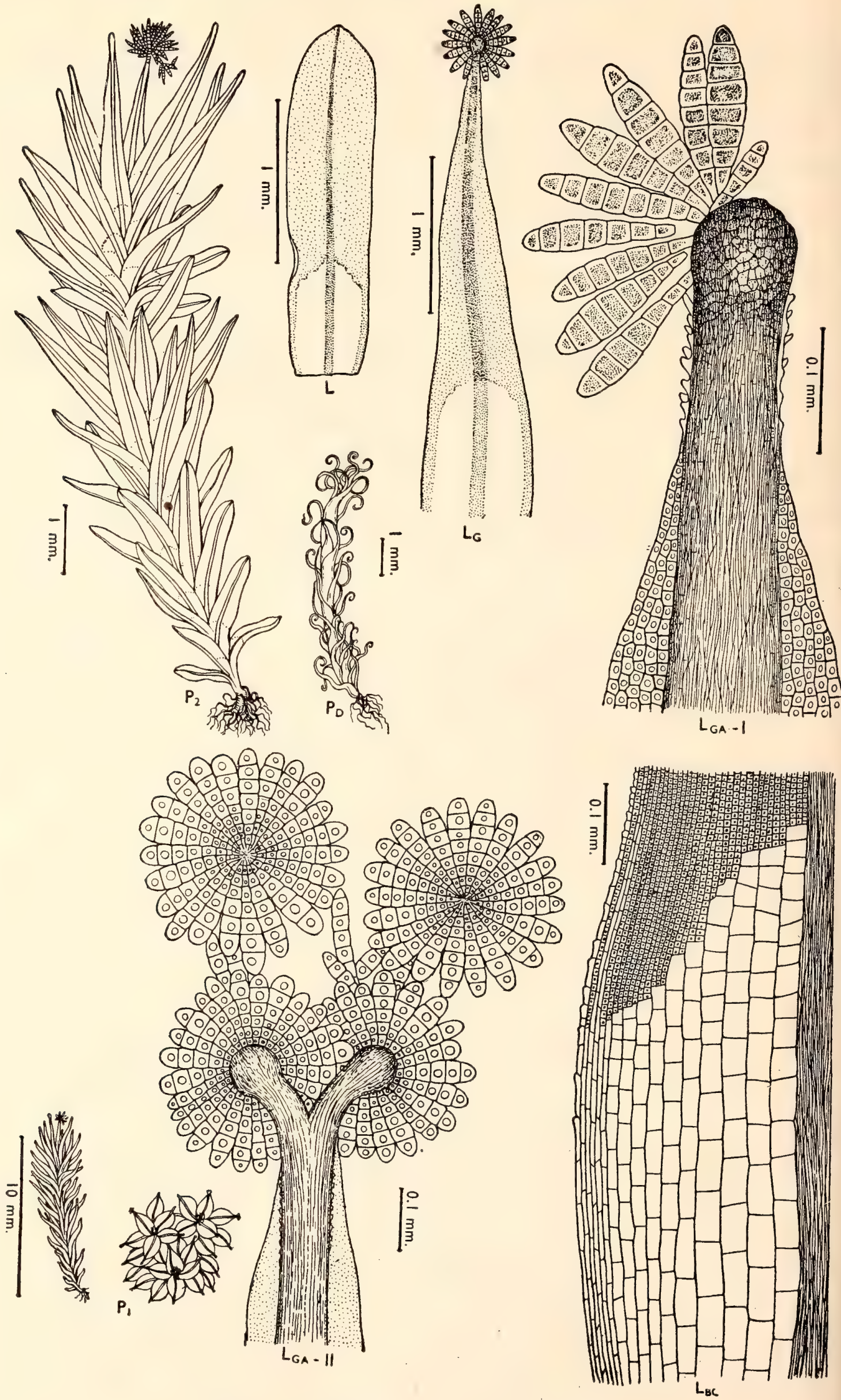
1 mm.
L
1 mm.
L_G
0.1 mm.
1 mm.
P_2
1 mm.
P_D
L_{GA}-I
0.1 mm.
10 mm.
P_1
0.1 mm.
L_{GA}-II
L_{BC}

Fig. 83. *Calymperes tenerum* C. Mueller

(*Gangulee* 774). L_{GA}-I & L_{GA}-II show normal and abnormal tips of gemmiferous leaves. Right hand P_1 figure shows top view of a cluster of plants.

gemmae leaves longer and narrower at top, ± 3 mm. long and 0.7 mm. broad at base (sometimes even broader). Chlorophyllose lamina cells hexagonal to quadrate, swollen with one or several coarse papillae, ± 5.5 μ wide, 5.5.-7 μ long. Leaf margin smooth at tip, may be slightly denticulate at base. Cancellinae within leaf base, ± 0.75 mm. high, of about 10 rows of pellucid, elongated, rectangular cells on both sides of costa ; cells very large (± 130×37 μ) near costa gradually becoming narrower towards margin and bordered by about 6 rows of elongated, very narrow cells at the margin, 2 rows of these cells may extend to a little above the base as very short tenioli. Costa prominent, percurrent in normal leaves but excurrent into a club-like structure (which may branch by splitting in some cases) in gemmiferous leaves bearing the radiating brood bodies in star-like clusters. Gemmae 134×36 μ, green, germinating from tip forming a protonemous hypha. Not known in fruiting condition in this area.

Distribution. Bengal, *Kurz* ; *Gangulee* 774, 2436, 3057, etc. all from Calcutta and its suburbs.

Malay, Sumatra, Java, New Caledonia.

6. **Calymperes burmense** Hampe ex Bescherelle in *Ann. Sci. Nat. Bot.*, Ser. 8, **1** : 279, 1896.

C. crocatum Hampe *nom. nud.* ex Bescherelle in *Ann. Sci. Nat. Bot.*, Ser. 8, **1** : 281, 1896.

Subgenus *Hyophilina.* Section *Climacina.* Epiphytic plants with usually unbranched, erect stems up to 1.25 cm. long. Normal leaves carinate-lingulate with an acute, acuminate apex, up to 2.75 mm. long ; erect when moist, when dry convolute, falcate-inflexed and twisted. Leaf base oblong, concave, broader in the upper ones. Chlorophyllose lamella cells small, quadrate, ± 7×6 μ, papillose but not obscure ; marginal row of same width but slightly longer and denticulate. Cancellinae 1 to 1.2 mm. high, formed by about 9 rows of pellucid, quadrate to rectangular cells (larger ones about 38×30 μ) descending like a staircase and becoming smaller towards the margin, then bordered by about 7 rows of hyaline, elongated cells and a marginal layer of small, denticulate cells. The inner rows of the border extend into *tenioli* of 2 to 3 rows of elongated cells, 2 to 3 layers in thickness and reaching almost the apex of the leaf. Lower immature leaves ovate with rounded tip and ovate-topped cancellinae. Upper gemmiferous leaves more elongated, with narrower limb, canaliculate, ± 4.5 mm. long but the topmost one may be as long as 6.5 mm. and with a spoon-like extension of the lamina at the tip. Costa narrow, about 70 μ broad, rough on top back, percurrent in lower leaves but excurrent in a gemmiferous tip in the upper leaves. Seta apical, straight, short (± 3 mm. long). Capsule permanently and

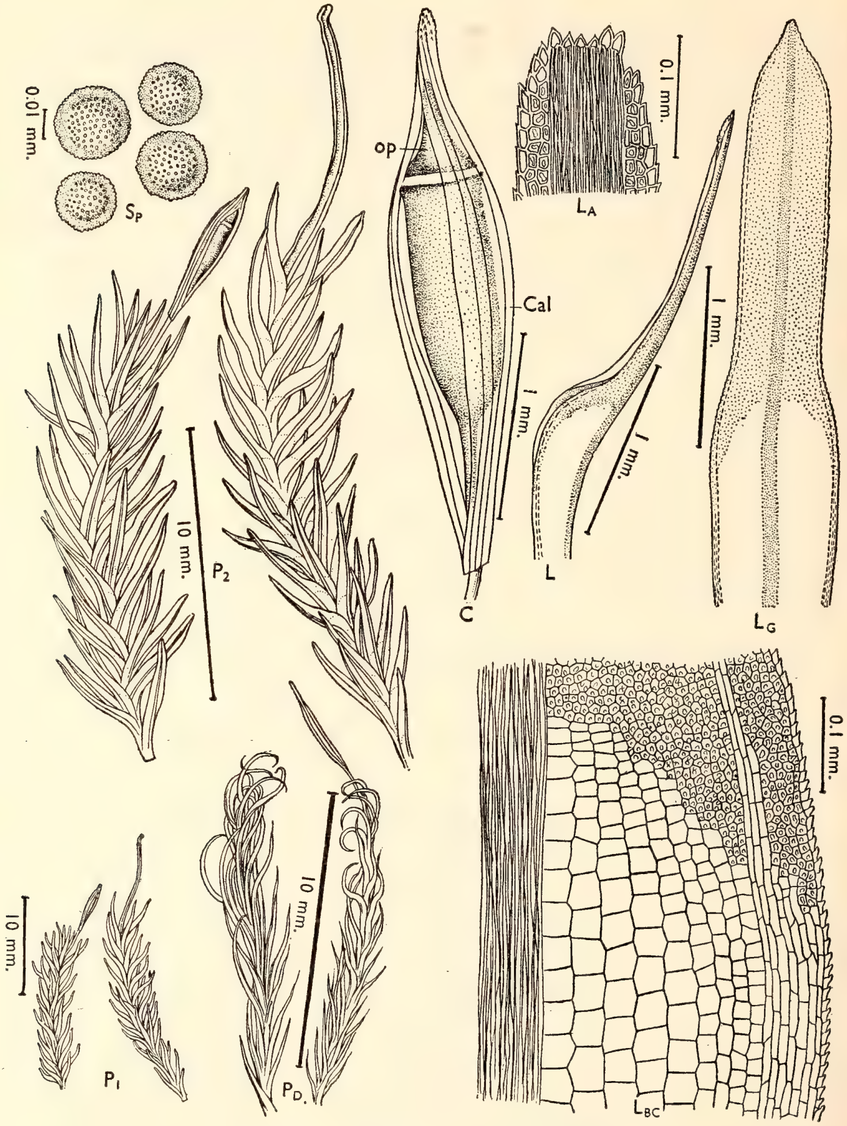
0.01 mm.
S_P
op
Cal
C
0.1 mm.
L_A
1 mm.
1 mm.
1 mm.
L
L_G
10 mm.
P_2
0.1 mm.
L_BC
10 mm.
P_1
10 mm.
P_D.

Fig. 84. *Calymperes burmense* Hampe
(*Gangulee*, 3005)

completely covered by a pleated hood-like calyptra the top of which is rough and reddish and the base narrow. Capsule cylindrical, ± 1.62 × 0.72 mm., with a conic-rostrate operculum about $\frac{1}{3}$ the capsule in height. Peristome absent. Spores light pellucid brown, papillose, 21 to 28 μ in diameter. Fruiting in October.

Distribution. Bengal Himalayas, *Gangulee* 3005; NEFA, *Bor* 2. Burma.

7. **Calymperes hampei** Dozy et Molkenboer in *Bryol. Jav.* **1** : 48, 1856.

Calymperes sandeanum Besch. in *Ann. Sci. Nat. Bot.*, Ser. 8, **1** : 303, 1896.
Calymperis naumanni Besch. ibid. : 294.
Calymperes varium Mitt. in Mason, Burmah, its People & Products, ed. 2 : 50, 1883 *nom. nud.*

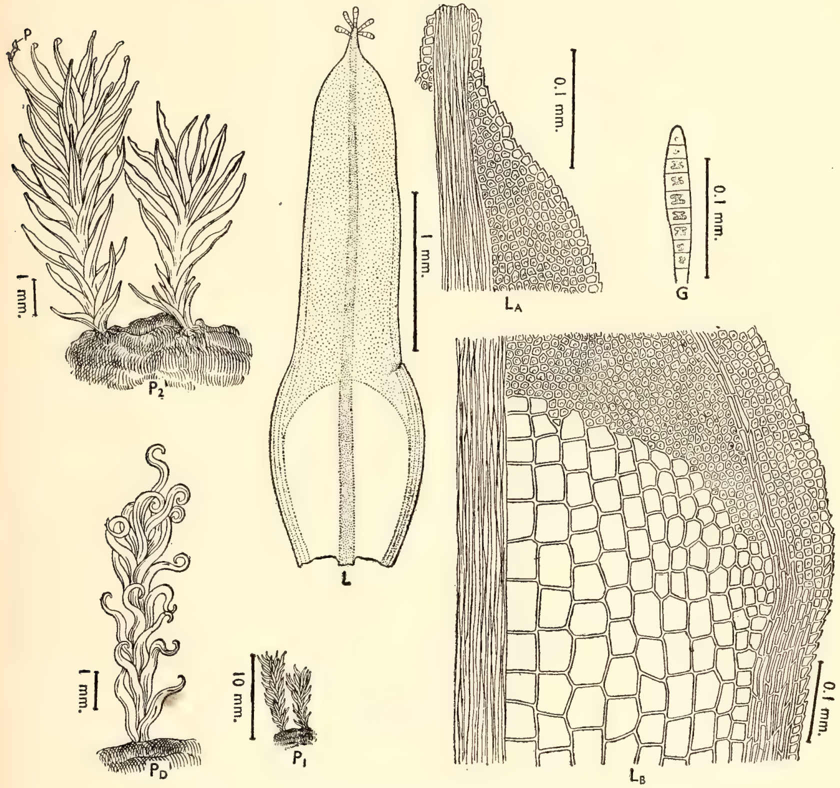

Fig. 85. *Calymperes hampei* Dozy et Molkenboer (*Fleischer* No. 64 from Java). P in P$_2$ shows a young plantling developing at leaf tip. L$_B$ is leaf base at top of cancellinae.

Subgenus *Hyophilina*, section *Eurycycla*. Caespitose, green, epiphytic plants with usually unbranched dark brown stems ; most plants up to 1 cm. long but some old plants up to 2 cm. long, covered with erecto-patent leaves which are strongly curled when dry. Leaves up to 3.25 mm. long ; sheathing leaf base broad (up to 1 mm. wide), whitish, carinate ovate, about $\frac{1}{3}$ of total leaf length ; upper lamina broadly lanceolate, margin finely denticulate, apex usually broadly rounded and then pointed with the excurrent vein. Chlorophyllose lamina cells very small (± 5 μ wide), irregularly quadrate, slightly incrassate, with short coarse papillae ; marginal row of cells longer (± 12 μ high) and causing serration almost throughout the leaf length. Cancellinae ± 1 mm. high with rounded ovate top, formed of up to 13 layers of hyaline, wide lighted, thin-walled, rectangular to square cells (up to 69 × 34 μ at middle near costa), somewhat irregular at top where it meets lamina cells. Tenioli extend to near leaf apex, formed of 2 to 3 layers of elongated, narrow, hyaline cells at top of cancellinae, reduced to one layer at top but extending to 7 or 8 layers at middle of leaf base, again narrowing to 4 or 5 rows at extreme base. 6 or 7 rows of marginal cells (similar but slightly bigger than the small lamina cells) beyond tenioli at top of cancellinae, gradually decreasing and vanishing at base but the margin layer of denticulate cells may be traced almost halfway down the leaf base. Costa light brown, rounded in lamina, excurrent into a gemmiferous tip. Tips of upper gemmiferous leaves often expanded like spoons. Gemmae elongated, narrowly club-shaped; ± 133 × 10 μ with about 10 cells in a linear row. Gemmiferous leaves also show young plants developing on the leaf tips. Fruiting plants not seen.

Distribution. NEFA, *Bor* 173.
Burma, Sumatra, Java, Borneo, Timor.

8. **Calymperes calcuttense** Bartram et Gangulee sp. nov.

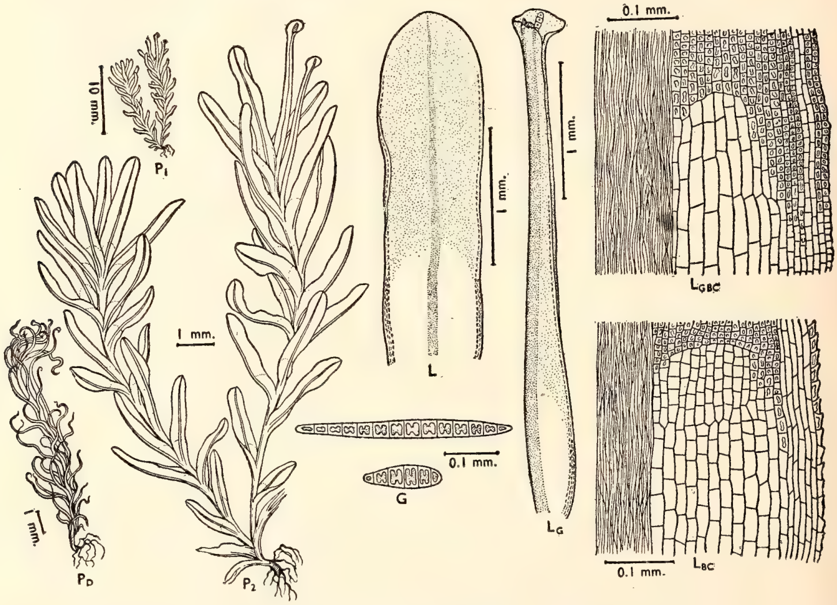

Fig. 86. *Calymperes calcuttense* Bartram et Gangulee sp. nov.
(*Gangulee* 3067)

Pertinet ad subgen. *Hyophilina*, sect. *Eurycycla*. Herba laxa, viridis, epiphytica, culmis ad 1.2 cm. longis, crescens simul cum *Taxithelium*

nepalense (Schwaegr.) Broth. Folia ordinaria erecta vel erecto-patentia cum madida, inflexa et curvata cum sicca, ad 3.5 mm. longa, 0.75 mm. lata, late ligulata ex basi concava, quae lamina latior non est, marginibus plus minusve planis, minute denticulatis, apicibus latis et rotundatis. Tenioli eminentiores in inferioribus foliis, apicem fere attingentes. Cancellinae ± 0.75 mm. altae, apice rotundato vel ovato, efformatae seriebus 12 ad 14 cellularum rectangularium hyalinarum magnarum (usque ad 49 × 18 μ) ad utrumque latus costae ; cellulae minores evadunt in apice ipso atque admixtae sunt cellulis superioribus chlorophyllosis lamellatis, circumdatae seriebus ± senis cellularum hyalinarum elongatarum, quarum eae ad seriem marginalem tantum pertinentes breviores sunt atque denticulatae. Costa angusta, ± 85 μ lata, percurrens, papillosa ad dorsum. Laminarum cellulae minutae, quadratae, ± 8 μ latae, densae et papillosae. Folia gemmifera angustiora atque plus elongata, canaliculata per totum, usque ad 4.8 mm. longa, 0.36 mm. lata ad basin, quae est latior, fastigata supra ; apices dilatantur ad modum cochlearis, ibique gemmae includuntur ; cancellinae cellularum magnarum (ad 85 × 20 μ) hyalinarum rectangularium ad utrumque latus costae, ovatae supra, margine constante e sena vel septenta serie cellularum nonnihil elongatarum et serie marginali cellularum minutarum denticulatarum. Tenioli unius seriei ex superiore parte cancellinarum fere ad apicem. Cellulae superiores chlorophyllosae quadratae, ± 9 μ longae, gradatim minores ex costa ad marginem, densae, papillosae. Gemmae ± 158 × 38 μ, sed nonnullae ad 425 μ longae. Capsulae ignotae hoc in loco.

Typus lectus ab H.C. Gangulee ad Sonarpur prope Calcuttam mense novembri anni 1957 et positus in Presidency College, Calcutta sub numero *Gangulee* 3067; isotypus positus in herbario Bartrami in U.S.A. sub eodem numero *Gangulee* 3067.

Subgenus *Hyophilina* ; Section *Eurycycla*. Lax green epiphytic plants with stems up to 1.2 cm. long, simple or branched, growing mixed with *Taxithelium nepalense* (Schwaegr.) Broth. Normal leaves erect to erecto-spreading when moist, curled and twisted when dry; up to 3.5 mm. long and 0.75 mm. wide, broadly ligulate from a concave, rectangular base which is not broader ; margin more or less flat, minutely denticulate ; apex broad and rounded. Tenioli more prominent in lower leaves, reaching almost the apex. Cancellinae ± 0.75 mm. high, top rounded to ovate, formed of 12 to 14 rows of hyaline rectangular cells (up to 49 × 18 μ) on both sides of costa, cells becoming smaller just at the top and merging with the upper chlorophyllose lamellar cells, bordered by about 6 rows of elongated hyaline cells of which the border row cells are shorter and denticulate. Costa narrow, ± 85 μ wide, percurrent papillose back. Lamina cells small, quadrate, ± 8 μ wide, dense and papillose and subobscure. Gemmiferous leaves narrower and more

elongated, canaliculate throughout, up to 4.8 mm. long and 0.36 mm. wide at base which is broader, tapering above ; the tip widens out like a spoon within which the gemmae are wholly or partly enclosed ; cancellinae of about 9 rows of large rectangular hyaline cells (up to 85 × 20 μ) on each side of costa with ovate top, border of 6 or 7 rows of somewhat elongated cells and a marginal row of small denticulate cells ; tenioli of one row from top of cancellinae almost to tip ; upper chlorophyllose cells quadrate, ± 9 μ long progressively smaller from costa to margin, dense, papillose. Gemmae ± 158 × 38 μ but there are a few as long as 425 μ. Capsules not formed in this locality.

Differs from *C. hampei* in the oblong-ligulate leaves broadly rounded at apex and not wider at base.

Collected by author from Sonarpur near Calcutta in November 1957 and named by E. B. Bartram.

Distribution. Lower Bengal, *Gangulee* 3067.

9. **Calymperes noakhalensis** Brühl & Sarkar in *J. Dept. Sci. Cal. Uni.* **10** : 3, 1929.

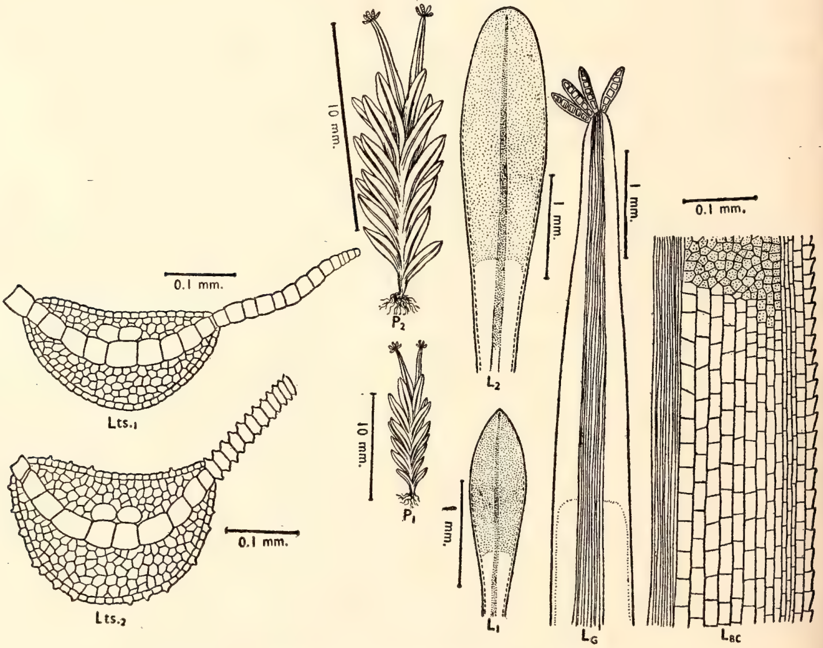

Fig. 87. *Calymperes noakhalensis* Brühl et Sarkar (After Brühl & Sarkar). L_1=lower leaf, L_2=upper normal leaf, L_G=upper gemmiferous leaf, $L_{ts.1}$=t.s. of leaf base, $L_{ts.2}$=t.s. of upper leaf.

Hyophilina. Plants in cushions of *Octoblepharum albidum* Hedw. associated with *Leucophanes octoblepharoides* Brid. growing on palm trees. Stems 10-15 mm. long, densely foliose. Leaves erecto-patent, flexuose or variously twisted when dry; lower leaves oblanceolate-spathulate, submucronate at apex due to slightly excurrent costa, ± 2 mm. long and 0.5 mm. broad above middle ; middle and upper normal leaves narrow spathulate or lingulate, rounded at apex, narrow at base, 3.3 to 4 mm. long, 0.6-0.9 mm. broad at upper half, 0.3-0.4 mm. broad at base ; leaf margin entire or minutely serrulate, undulate, sheathing part $\frac{1}{3}$ of whole leaf. Abnormal gemmiferous leaves 5-6 mm. long, ± 0.1 mm. broad at upper part. Costa $\frac{1}{3}$ of lamina broad at base, bearing a cluster of small, spindle-shaped gemmae at leaf tip. Costa of normal leaves not reaching leaf tip. Deuter cells in a median row, accompanied on the ventral side by two or three similar deuter cells ; cells on both sides of deuter numerous, much smaller, peripheral cells on costa papillose on upper half. Boundary between cancellinae and laminal cells not step-like, cancellinae more or less rectangular, large transparent cells near costa 38-44 μ long, upper crosswalls more or less oblique, cells broad near costa but the breadth gradually diminishes towards margin, uppermost cells distinctly shorter. Laminar cells irregularly quadrate, 8 to 10 μ in diameter, papillose. Tenioli extending from above base to $\frac{3}{4}$ of leaf length, 3 to 2 rows of 30-40 × 6-10 μ cells. Marginal cells in two rows, somewhat longer than broad, outer row slightly serrulate by projection of upper corners.

Differs from *C. hampei* and *C. moluccense* by the leaf base, midrib not excurrent in normal upper leaves and tenioli of not more than 3 rows.

As the type specimen could not be traced, the description and figures are based on those given by the authors.

Distribution. East Bengal, *Sarkar.*

10. **Calymperes heterophyllum** (Mitten) Bescherelle in *Ann. Sci. Nat. Bot.*, Ser. 8, **1** : 286, 1896.

Syrrhopodon heterophyllus Mitt. in *Musc. Ind. Or.* 40, 1859.

Eucampylopus. Lax caespitose, comparatively sturdy plants with branched stems up to 3 cm. long, uniformly covered with erecto-patent leaves which are curled to falcate when dry. Leaves carinate-lanceolate with a broad apex, up to 3.2 mm. long and 0.25 mm. wide in the comparatively broader, oblong, sheathing, concave base which is about $\frac{1}{6}$ of the total leaf length. Upper leaves longer, up to 3.6 mm. long and 0.36 mm. broad in the base which is more abruptly wider in these leaves. Chlorophyllose lamina cells very small, quadrate, 3 to 5 μ wide, densely papillose with many blunt papillae and obscure ; marginal row of cells bigger (up to 11.2 μ in height), clearer and causing a serrate margin of the leaf from tip almost to base. Cancellinae ± 1.22 mm. high in lower leaves and 0.9 mm. in the upper leaves formed of up to 9 rows of thin-walled, quadrate to rectangular, hyaline cells which are up to 42 × 33 μ near costa. Cancellinae top obovate to slightly pointed; the hyaline cells are bordered by the tenioli of transparent, narrow, elongated cells, 3 rows at top of cancellinae, extending to about 8 rows below. The tenioli bordered on the margin by 4 or 5 rows of smaller cells as on top lamina, the outermost row of which is the serrulate outer margin. The tenioli becomes narrower (2 or 1 layer) above the cancellinae and extends to a little below tip. Costa rough on back, light brown, about 61 μ wide at base, excurrent into a gemmiferous tip in all the upper leaves. The gemmae germinate by forming protonema-like filaments.

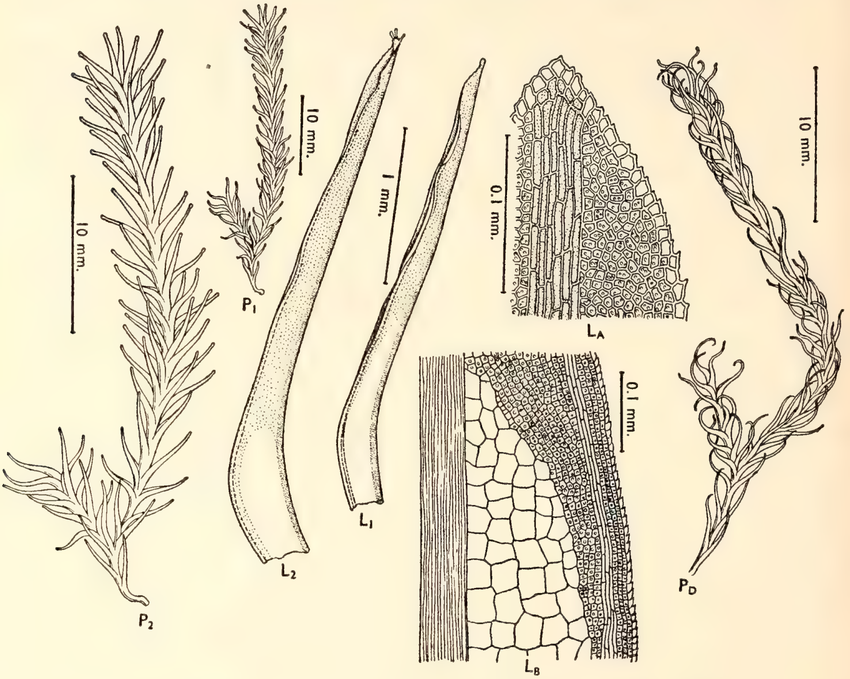

Fig. 88. *Calymperes heterophyllum* (Mitten) Bescherelle (*Gardner* from Ceylon). L_B at top of cancellinae. L_1 and L_2 show two different types of leaves.

Distribution. Nepal, *Wallich.*
Ceylon.

ACKNOWLEDGEMENTS

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SUMMARY

This fourth paper of the series dealing with the mosses of eastern India describes the families Leucobryaceae (last family of the series DICRANALES) and Calymperaceae (first family of the series POTTIALES). Leucobryaceae are represented in this area by 10 species in 5 genera, viz. *Leucophanes* (1 sp.), *Leucobryum* (6 spp.), *Ochrobryum* (1 sp.), *Octoblepharum* (1 sp.), and *Exodictyon* (1 sp.). Calymperaceae are represented by 10 species in 3 genera, viz. *Syrrhopodon* (2 spp.), *Thyridium* (2 spp.), and *Calymperes* (6 spp. including a new one). All these species (including the new species *Calymperes calcuttense* Bartram et Gangulee) are described and illustrated here. Necessary identification keys are also provided.

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The Birds of Nepal

PART 11

BY

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[*Continued from Vol.* **60** (2) : 399]

Family DICRURIDAE

748. **Dicrurus macrocercus albirictus** (Hodgson). Himalayan Black Drongo.

DUN : Hitaura : 1 imm. ♂ (May 14). CHITLANG VALLEY : Chitlang : 1♂ (March 14). NEPAL VALLEY : Maharajganj, Kathmandu, Patan, Bandegaon, Thankot : 4 ♂♂, 3 imm. ♂♂, 3 ♀♀, 2 imm. ♀♀ (March 21, April 4-14, May 5, 17).

The Black Drongo is very common in central Nepal from about 455 m. up to at least 1370 m. It occurs in and about villages, gardens, cultivation, light woods, open fields, etc.

It has also been recorded in eastern Nepal by Ripley (1950b, p. 413) and Biswas (1960a), and in west-central and eastern Nepal by Rand & Fleming (1957, pp. 104-105).

The males were noticed to chase females in the Nepal Valley from early April and they were fully breeding from the beginning of May. By the third week of March the gonads had already started swelling and in May they were fully developed. Thus, an adult male taken March 21, had slightly swollen testes, measuring R: 6.5×4, L: 7×4 mm.; another adult male on April 8 had them more developed (R: 11×6 mm., L: damaged); the adult male shot on May 5 had enormous testes (R: 17×11.5, L: 19.5×9 mm.); and an adult female taken May 17 was actually laying, there being a broken shelled egg in the oviduct.

Colours of soft parts : Iris blood red to deep crimson (reddish brown to brownish red in first year birds) ; bill, legs, feet and claws black ; pads grey.

Immature specimens:

All the six specimens referred to above as immature are first year birds. Their plumage corresponds with the description of first year birds as given by Whistler (1935, p. 316). Two of the April specimens, both females taken April 4 and 13, are very similar and appear younger than the immature May birds. They have the upper side with very little gloss; rump greyish; upper tail coverts tipped white; primaries brown; axillaries greyish; under wing coverts tipped white; underside brownish; abdomen, vent and under tail coverts fringed with white; irides reddish brown; and non-breeding condition of the ovaries.

The first year birds of May 5 and 17 are in similar plumage. They have blacker and more glossy upper parts and sides of the breast; almost black but not glossy rump; reduced white on the tips of upper tail coverts; brownish primaries; blacker axillaries; under wing coverts blacker and with reduced amount of white on the tips; blacker underside, the May 17 specimen being more so; reduced white on abdomen and vent, more reduced on the May 17 specimen; irides brownish red; testes enlarged (May 5: R: 8×5, L: 8×4.5; May 17: R: 8×5.5, L: 10.5×4.5 mm.). The May 5 specimen was seen chasing a female in full adult plumage.

It would appear that corresponding with the gradual loss of brown and white in attaining the glossy black adult dress, there is a change in the colour of iris from brown of juvenile to blood red or deep crimson of adult through the addition of increased amount of red to brown in first year birds (reddish brown, brownish red). It would further appear that older first year birds (? all, or ? some) do breed. These factors seem analogous to those of the Blackheaded Oriole, *Oriolus x. xanthornus* (see Vol. **60** (2) p. 398).

Measurements :

	Wing	Tail		Bill
		length	depth of fork	
5 ♂♂ :	153, 154, 155 (2), 156	159, 166, 167, 169, 172	51, 55, 59, 63 (2)	25, 25.5, 26, 27, 27.5
3 ♀♀ :	149, 151, 153	159, 164, 166	48, 55, 56	26 (2), —

Ripley (1961, p. 287) prefers to combine the Asian *D. macrocercus* with the African species *D. adsimilis.*

749. **Dicrurus leucophaeus longicaudatus** A. Hay. Indian Grey Drongo.

DUN : Bhimphedi : 2 imm. ♂♂ (March 12, June 18). CHITLANG VALLEY: Chandragiri above Chitlang : 1 ♀ (April 18). NEPAL VALLEY : Kathmandu, Godavari, Thankot : 13 ♂♂, 1 imm. ♂, 3 ♀♀ (March 21-April 14, May 10, 20).

The Grey Drongo is very common in central Nepal, more so above *c.* 1065 m. It occurs about villages and towns, in gardens and groves, as well as in light forests.

It was preparing to breed from the third week of March. The specimens from this period onwards had their gonads in different progressive stages of enlargement, until the third week of May when specimens with fully breeding condition of gonads (e.g. ♂ with 16×10 mm. testes) were obtained.

Colours of soft parts : Iris blood red (brownish red in first year birds) ; bill, legs, feet and claws black ; pads grey.

Immature specimens:

All the three immature specimens are males in first year plumage. Of them, the June 18 specimen appears oldest from the amount of gloss and white fringes to the posterior ventral feathers. This specimen had brownish red iris and somewhat enlarged testes (R: 5×3, L: 9×5 mm.); it probably had already bred. The May 10 specimen looks a little younger. It also had brownish red iris, and enlarged testes (R: 9×6, L: 12×6 mm.). The other specimen (March 12) appears still younger. No notes on the coloration of its iris and the condition of its gonads are available.

As in the Black Drongo, *Dicrurus macrocercus albirictus* (p. 639), this species also appears to breed in the first year plumage.

Unusual behaviour of a first year specimen:

The oldest of the specimens in first year plumage, a male (Bhimphedi, June 18), indulged in what appeared to be an unusual behaviour. Three fledglings of the Lesser Racket-tailed Drongo (*Dicrurus remifer tectirostris*) were huddled close together on the branch of a tree, and the first year Grey Drongo was engaged in aerobatics before them (time: about 9 a.m.; air temperature: about 35° C.). The aerial display consisted of upward flights, followed by sudden somersaults in midair with dexterous twists and turns, and finally return to perch on the same branch on which the Racket-tailed Drongos were perched or on an adjacent branch of the tree. Each flight was short and in full view of the tiny spectators, and it was almost constantly uttering a harsh call. From time to time it also performed the normal sallies for hunting insects. I am unable to account for the aerobatic flights with certainty. Was it because the bird (which appeared to have bred for the first time in its life) for one reason or the other was in a gay mood that it was happily showing off all it knew about flying to the only spectators it could find—three baby Lesser Racket-tailed Drongos?

Measurements :

		13 ♂♂	4 ♀♀
Wing :		137, 138 (2), 139, 140 (3), 141 (2), 141.5, 142, 143, 147	134, 135, 136 (2)
Tail	length :	157, 159, 160 (2), 161, 162, 163, 166, 167 (2), 170, 175,—	153, 155, 163,—
	depth of fork :	60, 61, 64 (2), 65, 68 (2), 71, 72, 74, 75, 82,—	59, 62, 68,—
Bill :		26 (2), 26.5 (2), 27 (3), 27.5 (3), 28 (2),—	25.5, 26, 26.5, 27

750. **Dicrurus caerulescens caerulescens** (Linnaeus). Whitebellied Drongo.

Dun : Hitaura : 1 ♂ (June 6).

The Whitebellied Drongo appeared rather scarce in central Nepal. The single example listed above was the only one found by us.

While Scully (1879, pp. 271-272) found it common in the central dun in winter, Ripley (1950b, p. 414) and Rand & Fleming (1957, p. 105) reported it from the western tarai only.

This species was not mentioned in the catalogues of Hodgson's collections, but two skins presented by Hodgson to the British Museum, one from Nepal and the other from 'Behar' were listed by Sharpe (1877, p. 253).

My specimen is very worn.

Measurements : 1 ♂ : Wing 126+.

751. **Dicrurus annectans** (Hodgson). Crowbilled Drongo.

Dun : Hitaura, Paharé Ghat : 1 ♂, 4 imm. ♀♀ (May 18-June 12).

The Crowbilled Drongo did not appear to be common in central Nepal. We came across it only occasionally in the deeper parts of forests of the Hitaura dun, and we found it only singly.

This species does not seem to have been reported from Nepal since Hodgson's time, save for the present record.

The immature birds listed above are in the first year plumage. The May 29 specimen appears to be the youngest of the lot. Its bars on the underside are broad and very conspicuous. It had, however, a somewhat enlarged ovary (7.5×5 mm.) with two or three 1.5 mm. ova. The June 12 specimen had a more enlarged ovary (8×6 mm.) with the largest ova measuring 2.5 mm.

Colours of soft parts (of first year birds) *:* Iris dark brown; bill, legs, feet, and claws black; pads yellowish grey.

Measurements : 1 ♂ : Wing 148; tail : length 121, depth of fork 20; bill 30.

In addition to the characters that separate this species from *D. macrocercus*, as given by Baker (1924, p. 354), the bill of *D. annectans*, which is large, heavy (Vaurie, 1949b, p. 266) and more crow-like, will prove a characteristic feature of distinction (Fig. 3).

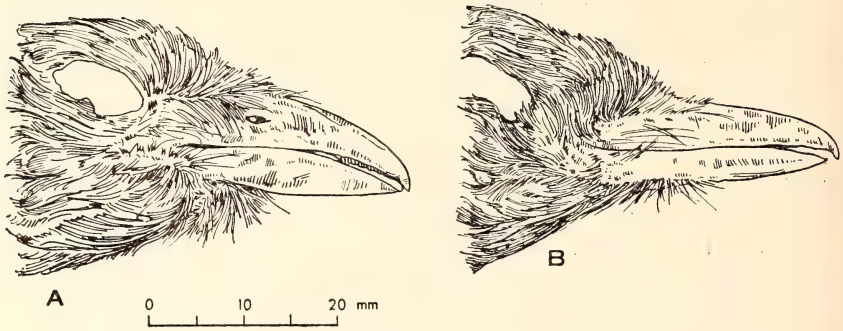

Fig. 3. Bills of *Dicrurus annectans* (**A**) and *Dicrurus macrocercus albirictus* (**B**) showing their characteristic shapes

752. **Dicrurus aeneus aeneus** Vieillot. Indian Bronze Drongo.

Bhabar : Amlekhganj : 1 ♂ (March 8). Dun : Hitaura, Bhimphedi : 2 ♂♂, 1 subad. ♂, 1 ♀, 2 imm. ♀♀ (March 12, May 12-15, June 17). Nepal Valley : Thankot : 1 ♂, 1 ♀ (March 25, 28).

The Bronze Drongo is occasionally seen in the forests of central Nepal. During spring and summer, it occurs singly or in loose parties.

Scully (1879, p. 272) who obtained specimens from the central dun, noted that 'it was never observed in the valley of Nepal, but Mr. Hodgson seems to have obtained it there in summer.' Ripley (1950b, p. 414) found it from the tarai up to *c.* 1220 m. (his single specimen was taken at Chisapani, *c.* 275 m., western Nepal). Rand & Fleming's (1957, p. 105) examples were taken in western and west-central Nepal at *c.* 915-1065 m. in winter.

The two immature females (Hitaura, May 12, 13) were evidently born early that season. They still have some sooty black down on the ventral side, and have grown only a few metallic feathers on the breast.

The Bronze Drongo was breeding in the Nepal Valley late in March, when males were seen chasing females, and a male specimen (March 28) had quite swollen testes (R: 9.5×6, L: 11.5×6 mm.). By June, breeding was over: one male taken June 17 at Bhimphedi (Dun) had almost non-breeding gonads.

Measurements :

	Wing	Tail		Bill
		length	depth of fork	
4 ♂♂ :	125, 127, 128(2)	119, 120, 123, 126	29 (2), 31, 33	22, 23, 24 (2)
2 ♀♀ :	125, 126	122, 126	32, 34	23, 23.5

753. **Dicrurus remifer tectirostris** (Hodgson). Indian Lesser Racket-tailed Drongo.

DUN : Bhimphedi : 2 ♂♂, 2 fledgling ♂♂, 1 nestling ♂, 2 ♀♀, 1 fledgling ♀, 1 nestling unsexed (May 4-12, June 18). MARKHU VALLEY : Deorali : 3 ♂♂, 2 ♀♀, 1 subad. ♀, 1 imm. ♀ (April 28, 29).

The Lesser Racket-tailed Drongo is occasionally seen in central Nepal. We noted it in small numbers between *c.* 1220 and 1830 m. on Mahabharat Range about clearings in the forests.

Scully (1879) and Ripley (1950b) were both unable to locate it in Nepal, but Rand & Fleming (1957, p. 106) reported it from the western tarai and the Nepal Valley in January, and Biswas (1960a) from Ramechhāp district, eastern Nepal, at *c.* 1220 m. in January.

The immature female specimen (April 28) is in the first annual plumage, and the subadult female (April 28) is in the second annual plumage as described by Vaurie (1949b, p. 271). The three fledglings (2 ♂♂, 1 ♀, June 18) were huddled close together on the branch of a tree and evidently belonged to the same brood.

Measurements :

		5 ♂♂	4 ♀♀
	Wing :	140, 142, 144 (2), 149	139, 140 (2), 141
Tail	central feather :	121, 122, 123, 126, 129	118, 120, 125, 126
	outer feather[1] (L/R) :	397/401, —/444, —/457, 423/—, 439/443	388/—, —/324+, —/353, —/—
	bare shaft (L/R) :	185/186, 206/202, 206/—, —/210, 240/227	162/—, —/137, —/140, —/—
	length of racket (L/R):	90/—, 91/95, —/95, 100/—101, —/105	96/—, —/81+, —/84, —/—
	width of racket (L/R) :	19/18, 20/—, —/21, —/23, 22/22	23/—, —/25, —/25, —/—
	Bill :	26, 26.5, 27, 27.5, 29	26.5, 27, 27.5, 28

[1] Up to the base of the shaft

754. **Dicrurus hottentottus hottentottus** (Linnaeus). Indian Haircrested Drongo.

TARAI : Simra : 2 ♂♂ (March 5). BHABAR : Amlekhganj : 1 subad. ♂, 1 ♀ (March 7, 9). DUN : Hitaura, Paharé Ghat : 2 ♂♂, 1 imm. ♂, 1 nestling ♂, 1 subad. ♀, 3 imm. ♀♀ (May 27-June 13). NEPAL VALLEY : Godavari : 1 ♂ (May 13).

The Haircrested Drongo is not uncommon in central Nepal. We observed it to be commoner in the Hitaura dun than in the lower regions (the tarai and bhabar) and the higher regions (Bhimphedi dun upwards). In the Nepal Valley, however, it was seen only once, and the only other record of its occurrence there is by Rand & Fleming (1957, p. 106) who obtained a single juvenile female on Nagar Jong in February. It occurs singly in forests.

Rand & Fleming (loc. cit.) have also found it in western, west-central and eastern Nepal.

My nestling specimen (♂, June 13) has black down feathers on the body. Of my immature specimens, the one taken June 13 (♀) appears to be the youngest: it has downy feathers on the underside. Two other specimens (♀, June 7, ♂, June 11), which have all their remiges and rectrices still growing, are similar to those of adults in coloration. The female has no crest, very short hackles, almost bare axilla, tips of outer tail feathers not curling, brown iris, bill horny black with whitish on the tip, and had non-breeding gonad. The male appears a little older. It has started getting the crest which consists of five rudimentary filamentous feathers. Further, it has short hackles, uncurled outer tail feathers, a few white-tipped axillaries, dark brown iris, and had non-breeding testes.

The specimen from the Nepal Valley (♂, May 13) had slightly enlarged testes (R: 7.5×3, L: 6.5×3 mm.), but the adults taken in the duns late in May and early in June, had fully developed gonads.

Colours of soft parts : Iris brownish red to blood red ; bill, legs, feet and claws black ; pads dark grey.

Measurements :

	Wing	Tail	Bill
5 ♂♂ :	166.5, 168, 169 (2), 169.5	143, 144, 146, 147.5, 149	39, 41 (2), 42, 43
1 ♀ :	168	148	42.5

755. **Dicrurus paradiseus grandis** (Gould). Northern Large Racket-tailed Drongo.

TARAI : Simra : 1 ♂ (March 5).

We found the Large Racket-tailed Drongo rather uncommon in central Nepal. Our only specimen was taken in the dense forest of the tarai.

Scully (1879, p. 272) recorded only a captive bird from the lower hills of central Nepal; Ripley (1950b, p. 414) found it 'throughout the Terai', presumably including that of central region; and Rand & Fleming (1957, p. 106) had specimens from the lower regions of western, west-central and eastern Nepal.

Measurements : 1 ♂ : Wing 177 ; central tail feathers 160 ; outer tail feathers : left 463, right 468 ; length of racket : left 99, right 100 ; width of racket : left 27, right 28 ; bill from the anterior edge of nostril 25.

Family Artamidae

756. **Artamus fuscus** Vieillot. Ashy Swallow-Shrike.

Dun: Hitaura : 8 ♂♂, 5 ♀♀ (May 19-25, June 1).

The Ashy Swallow-Shrike did not appear to us to be particularly common in central Nepal, except about the Hitaura village in the central dun, where small parties consisting of two to six individuals were commonly met with. Isolated trees in cultivated fields (of maize at that time of the year) were noted to be its favourite launching base in that area.

Our specimens seem to be the only ones collected in Nepal since Hodgson's time. It has not been recorded by Scully (1879) or Rand & Fleming (1957), but Ripley (1950b, p. 383) who did not collect any example, found it to be common 'in the Terai, in open areas, and up to Bhimphedi' in central Nepal dun.

My specimens do not fully agree with the description given by Baker (1924, p. 348), especially in the coloration of the forehead, chin and throat, and wing. Rather, Deignan's (1945, p. 516) description seems to fit them well.

The specimens under report are all more less worn. The tail of a female (May 22), and the forehead, chin and throat of a male (June 1) are in moult.

Examples taken on June 1 (♂♂) had near breeding gonads, R: 8.25×7, 6×4.5; L: 5.5×3, 6×4.5 mm.

Colours of soft parts : Iris reddish brown to blood red (♂) ; bill bright mauve-blue with black tip (♂) ; legs and feet slaty, bluish slaty on the back of legs and sides of feet ; claws dark horny ; pads white.

Measurements :

	8 ♂♂	5 ♀♀
Wing :	132 (2), 136, 137, 138, 138+, 139, 140	132+, 133+, 134, 138,—
Tail :	56+, 57, 58 (2), 58.5, 61, 62, 64	53+, 54, 56, 57, —
Bill :	22 (3), 22.5 (3), 23, —	21 (2), 22 (2), 23

Family Corvidae

757. **Garrulus glandarius bispecularis** Vigors. Western Himalayan Jay.

Garrulus bispecularis Vigors, 1831, *Proc. zool. Soc. Lond.* (1) : 7. (Himalayas, restricted to Murree, West Pakistan, by Baker, 1922d, p. 63.)

758. **Garrulus glandarius interstinctus** Hartert. Eastern Himalayan Jay.

Dun: Bhimphedi: 1 ♂ (March 14). Markhu Valley: Deorali: 1 ♂, 1 juv. ♀ (May 2, July 2). Chitlang Valley : Chitlang, Chandragiri above Chitlang:

4 ♂♂ (March 15, April 18-21). Nepal Valley : Thankot, Crest of Chandragiri : 4 ♂♂, 8 ♀♀ (March 23-April 14).

The Himalayan Jay is a common bird of central Nepal between *c.* 1220 and 2285 m. in pine and oak forests.

The earlier Nepali records of the species are all from central Nepal, except Stevens's (1923a, p. 515) who reported it from the Mai Valley, eastern Nepal, at *c.* 2590 m. in March, and Biswas's (1960a) who observed it in Ramechhāp district, eastern Nepal, at *c.* 1830 m. in January.

The juvenile specimen (♀, July 2) is darker than the adults, and has some downy feathers on the abdomen and vent.

It was breeding on the Chandragiri during mid-April. One of the female examples collected there on April 14 had a somewhat exhausted ovary with a 13 mm. ovum. Another female taken the same day had its ovary only partially mature, its largest ovum being only 3 mm. in a 12×6.5 mm. ovary. This was, however, an anomalous ovary, being located on the right side instead of the left (see Biswas, 1961a).

Colours of soft parts : Iris brownish pink ; edges of eyelids dull pink ; bill dull black with whitish tip ; legs fleshy ; feet yellowish fleshy ; claws pale horny with whitish on bases ; pads white.

Measurements :

	10 ♂♂	8 ♀♀
Wing :	158, 164, 165, 166(2), 167, 168, 169(2), 171	158, 162(2), 163(2), 164(3)
Tail :	142, 143, 144, 145, 147, 148, 149, 150(2), 153	135, 139, 140(2), 143, 144, 145,—
Bill :	32(5), 33(4),—	30.5(3), 31(2), 31.5(2), 32

Ripley (1950b, p. 416) and Rand & Fleming (1957, p. 114) have identified their birds from central Nepal (Nepal Valley) as *bispecularis*. Examination of large series from central Nepal shows, however, that this area lies in the zone of intergradation between the western *bispecularis* and eastern *interstinctus*, all gradations between the two being found here. While Biswas did not obtain any specimen from eastern Nepal, Stevens's examples from that area have been identified as *interstinctus*. I am not aware of any known specimen of the species from western Nepal, but birds from that area will, in all probability, prove to be *bispecularis*, for the few skins from eastern Kumaon not far from western Nepal border, that I have examined, no doubt belong to the western subspecies.

759. **Garrulus lanceolatus** Vigors. Blackthroated Jay.

Dun : Bhimphedi : 1 ♂ (March 12). Chitlang Valley : Chitlang : 1 ♂, 1 ♀ (April 17, 19).

The Blackthroated Jay was met with by us only on a few occasions between *c.* 1370 and 1830 m. in central Nepal. It was found singly in thinner parts of oak and pine forests.

Scully (1879) was unable to locate it in Nepal. Ripley (1950b, p. 416) and Rand & Fleming (1957, p. 113) recorded it also from western Nepal.

Our specimens are worn, those taken in April being more so.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	155+, 158	141,—	28(2)
1 ♀ :	151+	—	27.5

*760. **Cissa flavirostris cucullata** (Gould). Western Yellowbilled Blue Magpie.

*761. **Cissa flavirostris flavirostris** (Blyth). Eastern Yellowbilled Blue Magpie.

Scully (1879, p. 328) found the Yellowbilled Blue Magpie in the Nepal Valley and Nawakot district, central Nepal. Ripley (1950b, p. 415) reported it from the Tamur Valley, eastern Nepal, at *c.* 2440 m. upwards. Smythies (1950, p. 513) found it on Phulchauki Danda, Nepal Valley, at *c.* 2440 m. Proud (1952a, p. 361) observed it in the Gandak-Kosi watershed, central Nepal, at *c.* 2745 m. Rand & Fleming (1957, p. 110) recorded it from the Kali Gandak Valley, west-central Nepal, at *c.* 2135-2440 m., and in the Maulung Valley, eastern Nepal, at *c.* 3050 m.

The few central Nepali skins (Hodgson's earlier collection, as well as Scully's and Bailey's) of this magpie that I have been able to examine indicate that this area falls in the zone of intergradation between the western and eastern subspecies, the specimens showing a great deal of variation among them. This intergrading zone surely extends eastward up to at least the Maulung Valley, for Rand & Fleming's single specimen thence has been identified as belonging to the western race. Further eastward, probably from the Arun Valley, the birds are *flavirostris* (one Hodgson specimen presented to the British Museum in 1859, and Ripley's skins).

It may be pointed out here that Baker's (1922d, p. 43) description of *flavirostris* is not quite accurate for all characters. Thus, the nape is very pale bluish lilac and not white; the crown feathers are tipped very pale bluish lilac instead of white in the majority of specimens. In worn specimens the tips wear off and the feathers appear wholly black. Furthermore, the culmen cannot be 'about 65 mm.' when the bill from skull in 10 ♂♀ measures 37-42 (av. 40.4) mm.

762. **Cissa erythrorhyncha occipitalis** (Blyth). Redbilled Blue Magpie.

BHABAR : Amlekhganj : 1 ♂ (March 9). DUN : Hitaura : 2 juv. ♂♂, 2 ♀♀, 1 juv. ♀, 1 nestling ♀ (May 12, 15, June 13-16, July 14). NEPAL VALLEY : Godavari, Thankot : 3 ♂♂, 2 ♀♀ (April 14, May 10-13).

The Redbilled Blue Magpie is common in certain parts of central Nepal. Thus, we found a single specimen at Thankot for some days early in April, while during that period several parties were seen on the Chandragiri above Thankot. It was, however, very common at Godavari and above it on Phulchauki Danda during the second week of May. About Bhimphedi in the dun only a few parties were found, while it was common in a patch of forest situated between the Karra and Rapti rivers near Hitaura.

It occurs usually in small parties of four to six birds. It frequently feeds on the ground, walking awkwardly with such a long tail (*cf.* Rattray's observation mentioned by Baker, 1922d, p. 42). At Godavari a party was seen pecking at a baby Himalayan Cuckoo, *Cuculus saturatus*, see Part 2 of this series in the *Journal* 1960 (1961), **57** (3): 541-542, presumably stolen, and on examination it was found to have severe injuries on its head and abdomen caused by the predators' beaks.

Lowndes (1955, p. 29) reported it from the Marsiyandi Valley, central Nepal, at *c.* 915 m. in September; Rand & Fleming (1957, p. 109) found it in west-central Nepal at *c.* 610-915 m., and in eastern Nepal at *c.* 290 and 915 m. in winter; and Biswas (1960a) observed it in the Tamur Valley, eastern Nepal, at *c.* 1525 m. in June.

The two juvenile male specimens (June 15, 16) have no white spots on the forecrown, have the crown feathers sooty, centre of crown to nape white, and the tail growing. The juvenile female (July 14) is similar but with a longer tail. The nestling is also similarly coloured, but has down on abdomen and vent, and is smaller in size.

The May and June birds are worn.

In May the birds were very noisy and were chasing one another, presumably males chasing the females. The gonads were nearly ready in specimens taken May 10-13.

Colours of soft parts: Iris dark brown; eyelids brownish yellow; bill, legs and feet deep orange-red (in a female more orange, less red); claws horny, yellowish ochre on base; pads deep orange-red.

Measurements:

	Wing	Tail	Bill
4 ♂♂:	200, 202, 204, 207	440, 461, 464, 469	39, 41, 42(2)
4 ♀♀:	194+, 198, 199,—	414+,—(3)	39, 40, 41, 42

763. **Cissa chinensis chinensis** (Boddaert). Green Magpie.

DUN: Hitaura: 2 ♂♂, 5 ♀♀ (May 17-30).

The Green Magpie is not uncommon in the duns of central Nepal. It occurs in dense forests.

Scully (1879) did not record it from Nepal, and Ripley (1950b, p. 415) and Rand & Fleming (1957, p. 110) found it only in western Nepal.

The characteristic change of coloration of its plumage from green to blue in museum skins is commonly believed to be a post-mortem change. But surely it is not always so. Baker (1922d, pp. 45-46) noted that such changes might occur in live birds in ill-health or in captivity. It may be noted here that many specimens even in wild state (freshly killed) have varying amount of blue on their plumage. Thus, four of the seven specimens under report had already some blue on them when alive, and the following notes were made at the time of skinning:

1. ♂, May 17: Crown clear blue; slight blue wash on breast and abdomen.
2. ♂, May 30: Head pale blue; underparts washed with blue.
3. ♀, May 23: Crown clear blue; slight bluish wash on breast and abdomen.
4. ♀, May 30: Head pale blue; bluish band across breast.

All those skins were re-examined two years afterwards and were found to have changed considerably in coloration by becoming more or less completely blue.

The specimens are more or less worn.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	157,—	202+,—	39, 41
5 ♀♀ :	146+, 147, 149,—(2)	199, 202, 203,—(2)	35, 36, 38(2), 39

764. **Crypsirina vagabunda vagabunda** (Latham). Indian Tree Pie.

TARAI : Simra : 2 ♀♀ (March 4).

The Tree Pie did not appear to be common in central Nepal. We were unable to locate it in the Nepal Valley or in the areas south of it, except in the tarai and probably also in the Hitaura dun. In the last-named area once some tree pies were seen at a great distance nearly at dusk, and am not sure of their identity. Their pale coloration suggested that they were probably the Indian Tree Pie.

Scully (1879, pp. 328-329) found it fairly common between the bhabar and Hitaura dun. Ripley (1950b, p. 415) reported it from the tarai. Rand & Fleming (1957, p. 110) recorded it from *c.* 275-1370 m. in west-central and *c.* 275 m. in eastern Nepal.

Our specimens are worn, one being very much so.

Measurements : 2 ♀♀ : Wing 142+, 150 ; tail 210+, 222 ; bill 30.5, 31.

Three other skins, all unsexed, from central Nepal (two Hodgson skins in the British Museum from ' Kachar ' and Nepal Valley according to Kinnear's corrections made on the labels, and one in the Zoological Survey of India, taken by the Museum Collector) measure: Wing 147, 152(2); tail 226, 227,—; bill 30+, 31, 34.

As Ripley (loc. cit.) has pointed out, the central Nepal birds are close to *vagabunda* in coloration, but a little larger, thus leaning towards *pallida.*

765. **Crypsirina formosae himalayensis** (Blyth). Eastern Himalayan Tree Pie.

Dendrocitta himalayensis Blyth, 1865, *Ibis* (2)**1**: 45. (Himalayas, restricted to Sikkim by Ticehurst, 1925, p. 22.)

Dendrocitta formosae sarkari Kinnear & Whistler, 1930, *Bull. Brit. orn. Cl.* **51**: 17. [Anantagiri, Vishakhapatnam (= Vizagapatam) district, Andhra Pradesh.]

DUN: Hitaura, Kusumtar, Bhimphedi: 4 ♂♂, 1 juv. ♂, 1 ♀ (March 12-14, May 10-12, June 2, 3). NEPAL VALLEY: Godavari, Phulchauki Danda above Godavari, Thankot: 6 ♂♂, 5 ♀♀ (March 23-April 13, May 10-13).

The Eastern Himalayan Tree Pie is a common bird of central Nepal from the dun up to the Nepal Valley. A few were also observed at Amlekhganj in the bhabar. During spring and summer it occurs singly or in pairs in fairly dense, as well as lighter parts of forests.

Lowndes (1955, p. 29) found it in the Marsiyandi Valley, central Nepal, at *c.* 915 m. in September. Rand & Fleming (1957, p. 111) recorded it from west-central Nepal at *c.* 915-1370 m. in winter. In eastern Nepal, Biswas (1960a) came across it in the Irkhua Valley at *c.* 1220-1525 m. and in the Tamur Valley at *c.* 1525 m. during June.

My May and June specimens are worn.

Birds were chasing one another (presumably males chasing females) in April and May. The gonads of specimens taken April 1 (Thankot) and May 10-13 (Godavari) were approaching breeding condition, and that of June 2 (Kusumtar) was fully developed.

Colours of soft parts: Iris deep crimson or crimson-brown; bill black (once with the tip of the upper mandible horny); legs, feet and claws very deep horny or black; pads grey.

Measurements:

	10 ♂♂	6 ♀♀
Wing:	132+, 138, 144 (2), 145 (2), 146 (2), 147,—	136, 141 (2), 142, 146, 148
Tail:	205, 213, 215, 218, 222, 232, 235, 243,—(2)	202, 210, 212, 215, 221, 223
Bill:	34 (3), 35 (3), 36 (4)	33, 34 (2), 35 (3)

The isolated population of *C. formosae* in the northern Eastern Ghats described by Kinnear & Whistler (loc. cit.) as *sarkari* (with Anantagiri, Andhra Pradesh, as the type locality) and admitted by Ripley (1961, p. 311) and Vaurie (1962, p. 248), is said to differ from *himalayensis* only by having a smaller bill. This is not, however, borne out by my examination of the material of the species contained in the British Museum, the American Museum of Natural History and the Zoological Survey of India. This material includes three paratypes (with a topotype) of *sarkari*. The standard measurements of this material are as follows:

		Wing	Tail	Bill
W. Himalaya (Chenab Valley to Kumaon):	4 ♂♂ :	147-156	243-260	35-375.
[= *occidentalis* Ticehurst, 1925].		(152.5)[a]	(253.5)	(36.5)
	7 ♀♀ :	149-156	241-261	35-40
		(152.4)	(249.7)	(37.4)
	7 unsexed :	146-155	231-253	37-40
		(150.9)	(241.3)	(38.4)
E. Himalaya (Nepal to Assam) :	30 ♂♂ :	137-151	194-228	34-39.5
[= *himalayensis* Blyth, 1865].		(142.7)	(211)	(36.5)
	20 ♀♀ :	137-148	192-230	33.5-39
		(141.8)	(207.3)	(36.1)
	32 unsexed :	138-150	192-227	33-39
		(141.9)	(209.4)	(36.5)
N. Eastern Ghats[1] (Jeypore to Anantagiri) :	2 ♂♂ :	137, 142	203, 209	34, 35
[= '*sarkari*' Kinnear & Whistler, 1930].	1 ♀ :	143	201	35

[a] Average measurements are given in parentheses.

[1] Whistler & Kinnear (1932a, p. 517, note), and Abdulali (1949, p. 391) mention a specimen ex Horsfield collection from Madras. This specimen, an unsexed adult, collected by Wight (or ? Wright) is now in the British Museum. It measures: wing 151, tail 233, bill 37, and matches the western Himalayan *occidentalis*. Evidently, there must have been some error in the locality of the specimen.

It would appear from the measurements that *sarkari* fits in well within the subspecies *himalayensis*.

Baker's (1922d, p. 53) measurements of wing (132-140) and tail (200-210) of '*himalayensis*' (=*occidentalis*+*himalayensis*) are not correct, as may be seen from the measurements presented above.

*766. **Crypsirina frontalis frontalis** (Horsfield). Blackbrowed Tree Pie.

The only record of the occurrence of the Blackbrowed Tree Pie in Nepal is based on Hodgson's later collection (Horsfield & Moore, 1854, p. 570; Sharpe, 1877, p. 78).

*767. **Nucifraga caryocatactes macella** Thayer & Bangs. Eastern Nutcracker.

Scully (1879) did not find the nutcracker in Nepal. Stevens (1923a, p. 516) came across it on the Nepal side of the Singalila Range, eastern Nepal, at *c.* 2895-3505 m. in March-May. Ripley (1950b, p. 416) noted it in the Tamur Valley, eastern Nepal, at *c.* 2590 m. upwards in winter. Polunin (1955, p. 887) reported it from the Langtang Valley, central Nepal, up to *c.* 3960 m. in summer. Lowndes (1955, p. 29) found it in Manangbhot, central Nepal, at *c.* 3655 m. in summer. Rand & Fleming (1957, p. 111) recorded it from the Kali Gandak Valley, west-central Nepal, at *c.* 2590-2805 m. in winter, and in the Maulung Valley, eastern Nepal, at *c.* 3505 m. in winter. Biswas (1960a) heard it at *c.* 3505 m. in the Dudh Kosi Valley, eastern Nepal, in February.

Biswas (1950a) has shown that the Nepal birds belong to the eastern subspecies. Vaurie (1959a, p. 159; 1962, p. 257) has come to the same conclusion. However, Ripley (1961, pp. 312-313) has referred the Nepal birds to the western race *hemispila*.

*768. **Pyrrhocorax pyrrhocorax himalayanus** (Gould). Himalayan Redbilled Chough.

Like us, Scully (1879) and Ripley (1950b) were unable to find the Redbilled Chough in Nepal. Polunin (1955, p. 887) reported it from the Langtang Valley, central Nepal, at *c.* 3350 m. upwards in summer. Lowndes (1955, p. 30) noted it in Manangbhot, central Nepal, up to *c.* 4875 m. in summer. Rand & Fleming (1957, p. 111) recorded it from the Kali Gandak Valley, west-central Nepal, at *c.* 2745-2805 m. in winter. Biswas (1960a) found it in Khumbu, eastern Nepal, at *c.* 3655-4570 m. during February-April.

*769. **Pyrrhocorax graculus digitatus** Hemprich & Ehrenberg. Eastern Yellowbilled Chough.

The first record of the Yellowbilled Chough from Nepal was furnished by Stevens (1923a, p. 517) from the Nepal side of the Singalila Range, eastern Nepal, at *c.* 3610 m. in March. It has subsequently been reported by Lowndes (1955, p. 30) from Manangbhot, central Nepal, up to *c.* 4875 m. in summer, and Biswas (1960a) from Khumbu, eastern Nepal, at *c.* 3655-5425 m. during February-May.

770. **Corvus splendens splendens** Vieillot. Indian House Crow.

DUN : Hitaura : 1 ♂ (June 24). NEPAL VALLEY : Thankot : 4 ♂♂, (June 29).

The House Crow is very common in and around all the villages and towns of Nepal from the plains up to about 1525 m.

It was breeding in June.

Measurements : 5♂♂ : Wing 285, 287, 288, 290 (2) ; tail 174, 177, 178, 180, 186 ; bill 50, 51 (2), 55, 56.

771. **Corvus macrorhynchos intermedius** Adams. Himalayan Jungle Crow.

MARKHU VALLEY : Kulikhani, Deorali : 2 ♂♂, 1 ♀ (April 27-May 2). CHITLANG VALLEY : Chitlang : 1 ♂, 1 ♀ (April 19, 25). NEPAL VALLEY : Thankot : 1 juv. ♂ (May 20).

The Himalayan Jungle Crow is not uncommon about 1220 m. upwards. It is usually found in pairs or small parties, frequently away from human habitation. From April 13 to April 22, three or four birds were found every afternoon circling round above the pass on the crest of Chandragiri, with outstretched wings, sometimes diving down a little, flying up again, and cawing harshly all the time. This aerial display would go on for some time; then the party would break up, or the birds would fly normally down the northern or southern sides of the mountain out of sight. Scully (1879, p. 325) described similar flights, but had seen larger flocks of 50-60 birds.

Scully (loc. cit.) reported it from the Nepal Valley; Stevens (1923a, p. 513) from the Mai Valley, eastern Nepal, below *c.* 3505 m. in March-April; Ripley (1950b, p. 414) from the tarai 'up to the highest elevations'; Proud (1952a, p. 361) from the Gandak-Kosi watershed, central Nepal, at *c.* 3350-3655 m. in spring; Polunin (1955, p. 887) from the Langtang Valley, central Nepal, up to *c.* 3350 m. in summer; Rand & Fleming (1957, p. 108) in winter from the western tarai, the Kali Gandak Valley in west-central Nepal at *c.* 2745 m., and the Maulung Valley in eastern Nepal at *c.* 3505 m.; and Biswas (1960a) from the Sun Kosi Valley in central Nepal at *c.* 1370-2285 m. in January, Khumbu in eastern Nepal at *c.* 3655-4570 m. in February-May, and the Arun and Tamur valleys in eastern Nepal at *c.* 1220-1830 m. in June.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	316[a], 341, 350	199+[a], 218, 219+	61.5,62[a],—
2 ♀♀ :	310, 311+	178, 195+	60,-—

[a] This specimen has brownish primaries and may be a first year bird.

All the specimens listed above, and those taken by Scully in the Nepal Valley (now partly in the British Museum and partly in the Zoological Survey of India) have white bases of nape feathers, bill 56-65, and are not as black or as glossy as birds from Tibet or high Sikkim, thus differing from *tibetosinensis* Kleinschmidt & Weigold, 1922, as discussed by Vaurie (1954a, pp. 17-19). See also Rand & Fleming (op. cit., pp. 108-109) for comments on their specimens.

772. **Corvus macrorhynchos** (? subspecies).

DUN : Hitaura : 1 juv. ♂ (May 26).

Subspecific identification of such a young specimen was not possible for me.

It has, however, raised a question: What is the Jungle Crow that is found in the lower regions of Nepal?

All the jungle crows that were seen in the bhabar and the Hitaura dun looked distinctly smaller, in life, than the birds higher up (=*intermedius*), and their call was not quite so deep or loud. Moreover, juvenile *intermedius* has the bases of nape feathers white, but the juvenile specimen under report has them grey. Rand & Fleming's (1957, p. 109) specimen from Bilauri, western Nepal (*c.* 275 m.), which they placed under *intermedius*, also has them greyish.

Although nothing definite could be said until adult specimens are examined, the evidences presented above would indicate that the breeding birds of the lower regions of Nepal (below 600 m.) are not *intermedius*. They may possibly be, as Baker (1922d, p. 29) had indicated, intermediate between *intermedius* and the birds found in the plains immediately to the south of Nepal, which, curiously, are themselves intermediate between *culminatus* and *levaillanti* according to Whistler & Kinnear (1932a, p. 512). They advised to treat those birds as *culminatus*. An examination of carefully sexed series of the Jungle Crow from the lower regions of Nepal should yield interesting findings.

[**Corvus corax tibetanus** Hodgson. Tibetan Raven.

Lowndes (1955, p. 29) records the raven, *Corvus corax* (presumably the Tibetan Raven, *C. c. tibetanus* Hodgson) by sight in Manangbhot, central Nepal, between *c.* 4265 and 4570 m. in July-August.

No specimen of the species seems to have been taken in Nepal so far, although it is likely to occur in the plateau region north of the main Himalayan axis. In this connexion, it is interesting to note that both Baker (1922d, p. 23) and Ripley (1961, p. 318) have included Nepal within the range of the species, so has Vaurie (1962, p. 281) by implication.

A word of caution may here be said about sighting of the raven. From a distance, many specimens of the Himalayan Jungle Crow (*Corvus macrorhynchos intermedius*) in areas where the raven is likely to occur, look large enough to pass for the raven. It is only after collecting such specimens that their true identity is revealed. The characteristic neck hackles of the raven may not be clearly visible from a distance unless one pays particular attention to them through field glasses.]

(*To be continued*)

Copepods parasitic on South Indian Fishes: Family Anthosomidae—1

BY

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(*With seven text-figures*)

Anthosomid copepods of the genus *Lernanthropus* Blainville are extremely common gill parasites of the teleostean food fishes of this region but very few have so far been described. During the course of a year I have been able to collect a large number of species, of which eight are described here; four of them are new. In a previous publication (Pillai 1962) I described three species, one belonging to *Lernanthropus* and two to *Lernanthropodes* Bere.

Genus **Lernanthropus** Blainville

Lernanthropus giganteus Kroyer

Lernanthropus giganteus Kroyer, 1863, p. 280, pl. 8, figs. 1a-e; Wilson, 1913, p.227, pl. 33, figs. 148-150; Delamare-Douboutteville & Nunes-Ruivo, 1954, p.141.

Remarks. Wilson has given a detailed description and Delamare-Douboutteville & Nunes-Ruivo a detailed synonymy of this species and hence variations observed in my specimens alone are presented. Wilson has shown the posterior border of the dorsal plate of the female as faintly bilobed but described it as straight; it is straight in the present specimens. The antero-lateral lobes of the carapace reach the level of the antennal lobe and not beyond the latter as shown by Wilson. The long triangular postero-lateral processes of the anterior division of the trunk easily distinguish *L. giganteus*.

Length 7.1 mm.

38 females were collected by the author from the gills of *Caranx* sp. at Trivandrum.

Lernanthropus trifoliatus Bassett-Smith

Lernanthropus trifoliatus Bassett-Smith, 1898, p. 11, pl. 7, f. 3. nec *Lernanthropus trifoliatus* Kirtisinghe, 1956, p. 18, f. 11.

Text-fig. 1

Material. 2 females from *Polynemus plebeius* (Broussonet), 8 females from *Polynemus sextarius* Bloch, and a large number of females and males from *Polynemus heptadactylus* Cuvier were collected by the author at Trivandrum.

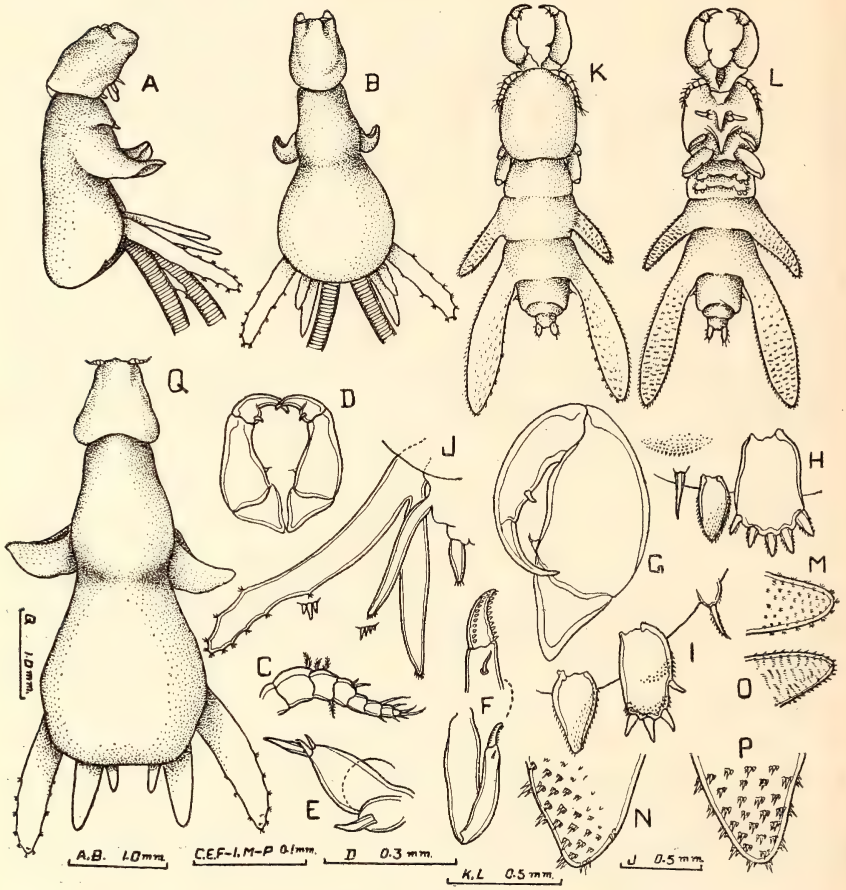

Fig. 1. *Lernanthropus trifoliatus* Bassett-Smith: A-J. female: A. lateral view; B. dorsal view; C. antenna 1; D. antenna 2; E. maxilla; F. maxilliped 1; G. maxilliped 2; H. leg 1; I. leg 2; J. posterior part of body showing legs 4, 5, and anal lamina. K-P. male: K. dorsal view; L. ventral view; M. tip of leg 3, dorsal view; N. tip of leg 4, dorsal view; O. tip of leg 3, ventral view; P. tip of leg 4, ventral view. Q. female from *Polynemus plebeius*

Female. Carapace longer than broad and posteriorly rounded, antennal area ill defined, antero-lateral parts produced into two prominent prolongations, lateral parts bent downwards. Anterior division of trunk rectangular, as long as carapace, with a slight bulging behind the position of the second legs. Dorsal plate rounded, longer than broad and demarcated from the anterior division of trunk by comparatively shallow lateral incisions. Genital segment fused with the fifth trunk segment, abdomen small. Anal laminae long ovate, with a row of apical spinules.

First antenna seven-segmented. Second antenna prehensile, its basal segment with a proximal spine-tipped papilla, distal segment with a swollen base carrying a claw. Maxilla bilobed, inner lobe ovate and with a stout spine, outer lobe large, with three spines, one of them stout. Basal segment of first maxilliped not much stouter than distal, latter with a claw, unguis barbed on both edges. Basal segment of second maxilliped with a spine-tipped papilla, distal segment long and strongly falcate, with a claw-like spine in the middle.

First pair of legs with stout exopod carrying five teeth, endopod small, ovate and spiny, inner spine on basipod large, with a patch of spinules near its base. Second pair of legs with rectangular spiny exopod carrying four teeth, endopod similar to that of first leg, outer spine on basipod pectinate. Third leg uniramous and rolled up, directed at right angles to the long axis of the body and apically curved forwards. Fourth pair of legs biramous, exopod longer and stouter than endopod, its distal half with several groups of small teeth, endopod with an apical bunch of spines. Fifth leg uniramous, slender and tipped with a row of spines.

Length 3.4 mm.

Male. Carapace longer than broad and clearly demarcated from the trunk. Trunk segments indicated by lateral incisions and dorsal grooves. First two segments fused, equal to third, third and fourth segments subequal and rectangular. Fifth segment roughly squarish, with a pair of spine-tipped papillae. Genital segment small, immersed in fifth segment. Abdomen very small. Third pair of legs short, as long as the width of the segment. Fourth pair large, remotely club-shaped, both pairs with spiny surface. Anal laminae ovate, longer than broad.

Total length 1.2 mm.

Remarks. Bassett-Smith's description of this species was based on females and to my knowledge the male has not been described so far. As pointed out by Kirtisinghe, Bassett-Smith mistook the fifth leg for a third ramus of the fourth leg. The specimens Kirtisinghe assigned to this species are, however, totally different from those described by Bassett-Smith. A very prominent character of this species is the spinulation of the exopod of the fourth leg of the female. The groups of spines make the border so irregular that it is surprising that Bassett-Smith makes no mention of them. During the present investigation *L. trifoliatus* was found to parasitise three different but closely related species. The one figured here was from

P. heptadactylus. The size of the parasite was found to vary proportionately to the size of the host. In the large specimens, collected from *P. plebeius*, the exopod of the fourth leg is club-shaped. This species is apparently slightly variable.

Lernanthropus cornutus Kirtisinghe

Lernanthropus cornutus Kirtisinghe, 1937, p. 448, figs. 88-98 ; Capart, 1953, p. 649; Delamare-Douboutteville & Nunes-Ruivo, 1954, p. 141.

Text-fig. 2

Material. Four females from the gills of *Tylosurus crocodilus* (Le Sueur) and 2 females and 1 male from the gills of *Belone* sp. were collected by the author at Trivandrum.

Female. Carapace roughly equal in length and breadth, regularly broadening backwards and postero-laterally produced into triangular apically blunt processes inclined backwards. Antennal area broad and folded downwards. Anterior division of trunk slightly longer than broad, roughly oblong, antero-median part produced into a conical prominence overlapping the carapace and continued backwards as a high median ridge reaching the hind border of the dorsal plate, the ridge progressively narrowing backwards. Dorsal plate demarcated from the anterior division of trunk by a mere lateral sinuosity, regularly broadening up to the middle, distal border roughly semicircular. Genital segment large, twice as broad as abdomen, abdomen slightly longer than broad.

First antenna small and indistinctly segmented. Second antenna strong, subequal in size to the second maxilliped, basal segment with the usual tubercle, distal segment stout, with a basal claw. Maxilla two-lobed, inner lobe not very much smaller than outer, prolonged into a conical spine, outer lobe with two spines. Unguis of first maxilliped with one inner and several outer rows of spines. Basal segment of second maxilliped oblong, claw of distal segment hook-like.

Exopod of first leg comparatively very large, with five dissimilar teeth, endopod small, with a long spine, setae on basipod large. Second leg very small, endopod larger than exopod. Third leg comparatively small, uniramous and folded as usual. Fourth leg biramous, not reaching the distal border of the dorsal plate, rami subequal, fusiform. Anal laminae ovate, with a spine-like apex.

Total length 4.2 mm.

Male. Cephalothorax almost equal in length and breadth, slightly broadening backwards and constricted in front to form an antennal area and behind to form a neck. First two trunk segments indistinct, genital segment and abdomen together forming a narrow conical indistinctly segmented lobe. Anal laminae longer than broad, with two pectinate and three non-pectinate setae. Third leg

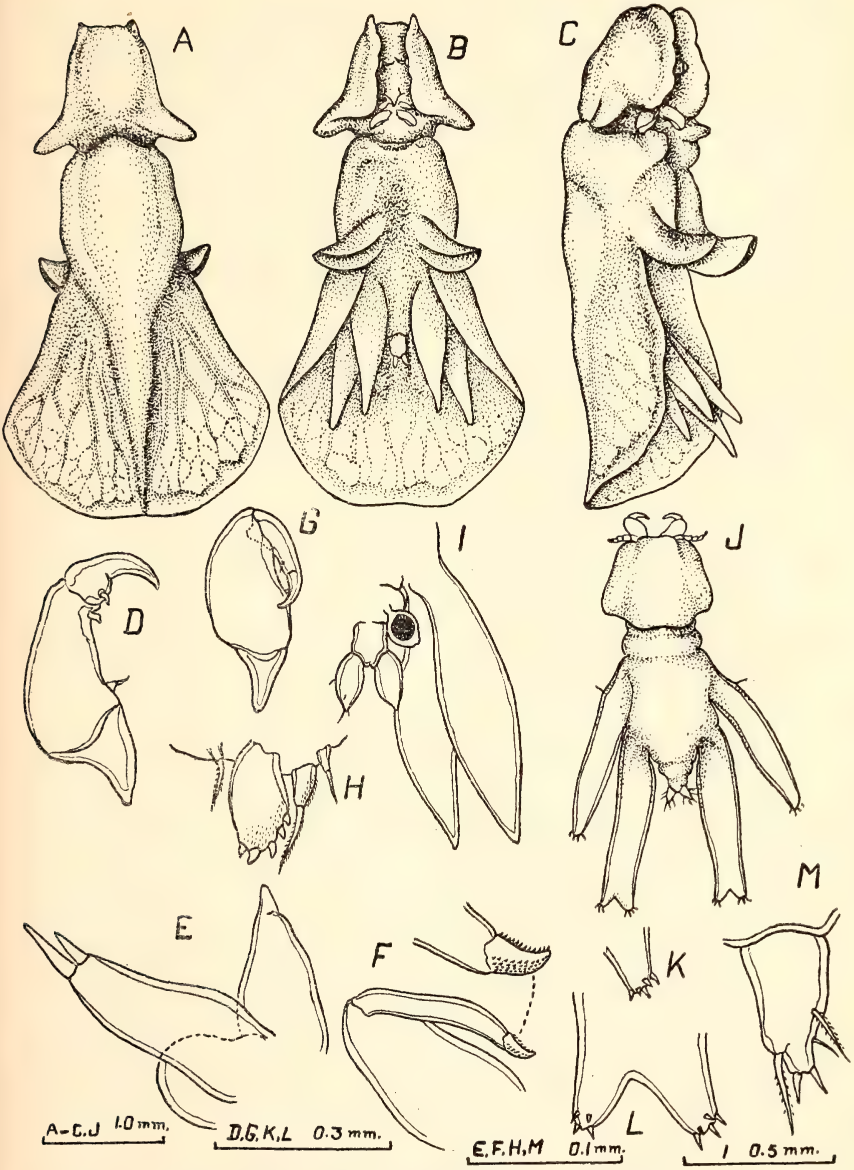

Fig. 2. *Lernanthropus cornutus* Kirtisinghe : A-I. female : A. dorsal view ; B. ventral view ; C. lateral view ; D. antenna 2 ; E. maxilla ; F. maxilliped 1 ; G. maxilliped 2 ; H. leg 1 ; I. posterior part of body showing leg 4 and anal laminae. J-M. male : J. dorsal view ; K. tip of leg 3 ; L. tip of leg 4; M. anal lamina.

long, tapering distally, base with one and apex with a bunch of short teeth. Fourth leg as long as third, parallel-sided and apically bifid, each ramus with an apical bunch of teeth.

Total length 2.1 mm.

Remarks. Kirtisinghe's description clearly applies to the present specimens except in the following characters. He has described the maxilla as two-jointed, basal segment spherical and with an accessory spine, and terminal segment smaller. As far as I could find this appendage is exactly as in other species, except that the inner lobe is comparatively large. It is possible that Kirtisinghe examined this appendage with the inner lobe lying over the outer. Kirtisinghe has described the fourth leg as projecting beyond the posterior border of the dorsal plate, but they are completely hidden under the dorsal plate in the specimens collected from *T. crocodilus* while in those collected from *Belone* they are as shown by Kirtisinghe. The latter specimens are larger than those from *Tylosurus*. Except that the third thoracic segment is clearly indicated and that the anal laminae carry spines, the present male is as described by Kirtisinghe.

Lernanthropus corniger Yamaguti

Lernanthropus corniger Yamaguti, 1954, p. 387, figs. 35-41.

Text-fig. 3

Material. 43 females and 2 males were collected from the gills of *Megalaspis cordyla* (Linn.) by the author at Trivandrum. Allotype, male, is deposited in the Indian Museum, Calcutta.

Female. Carapace comparatively very large, subequal to the anterior division of trunk, with two lateral constrictions. Antennal area prominent but not produced, antero-lateral parts produced into large foliaceous lobes dorsally appearing as two acute horns reaching far beyond the frontal margin, posterior border of carapace convex. Anterior division of trunk roughly squarish, abruptly enlarged at the posterior half, antero-lateral parts rounded and shoulder-like. Dorsal plate completely covering the abdomen and anal laminae, roughly circular and as long as the anterior division of the trunk. Genital segment large, abdomen narrow, anal laminae long, each with three to four setae.

First antenna five-segmented, with long setae, third segment with a very long seta. Second antenna strong, basal segment stout, with a spine-tipped papilla, distal segment half as long as basal, with two claws, inferior distal part produced below the unguis into a flattened lobe with irregular border, unguis claw-like. Maxilla two lobed, inner lobe with one and outer with three spines, one of the latter very large. Basal segment of first maxilliped stout, distal

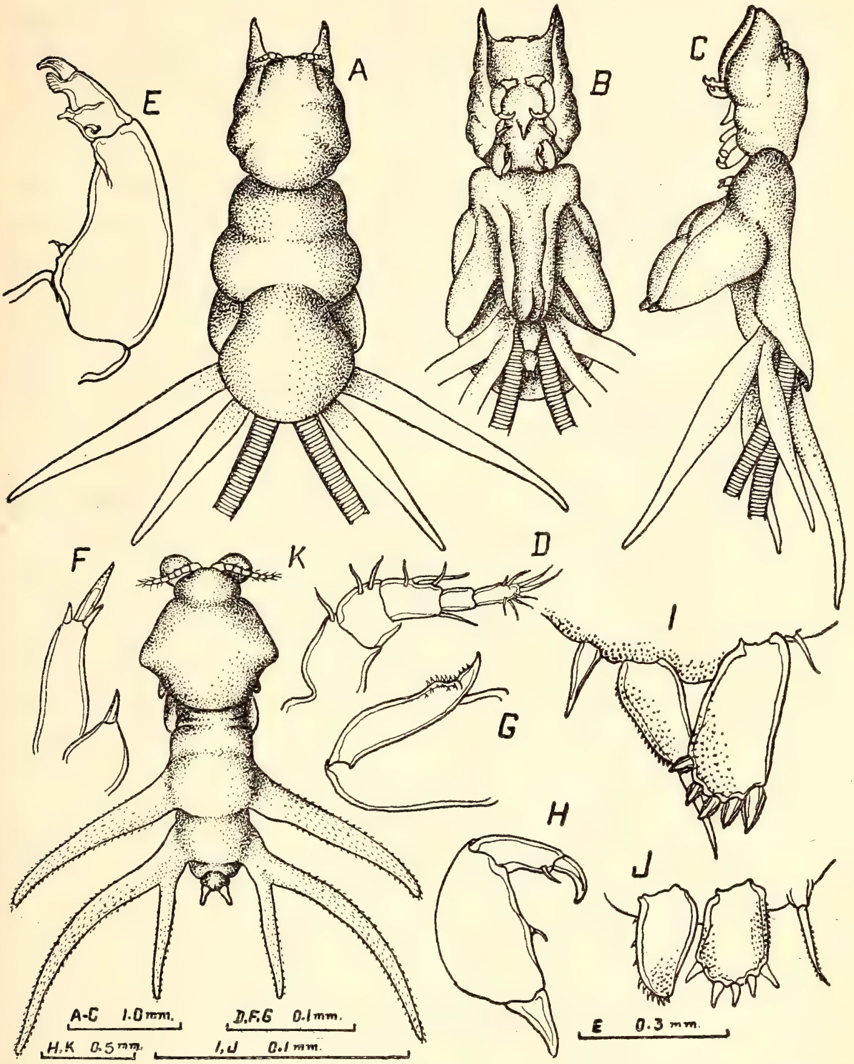

Fig. 3. *Lernanthropus corniger* Yamaguti: Female. A. dorsal view; B. ventral view; C. lateral view; D. antenna 1; E. antenna 2; F. maxilla; G. maxilliped 1; H. maxilliped 2: I. leg 1; J. leg 2. K. male

segment as long as basal, with a few sharp teeth at its inner distal part, unguis not clearly separated, with two to three teeth. Second maxilliped, as usual in the genus, uncinate, unguis strongly curved.

First pair of legs with a large exopod carrying five strong winged teeth, endopod with a stout spine, inner seta on basipod broad, outer seta small, basipod and the rami spiny. Basipod of second leg with stout outer seta, exopod with five teeth, endopod spiny but without the apical spine. Third leg biramous, exopod folded and facing downwards, endopods of the two sides fused except at the tip, outer margin of endopods curved towards the venter, producing a semicircular channel. Fourth leg with long slender rami, endopod shorter than exopod. Fifth leg absent.

Total length 3.1 mm.

Male. Cephalothorax much broader than rest of body, median lateral parts angular, producing a diamond shape, antennal area demarcated into a well-delimited lobe, posterior border rounded. Thoracic segments indicated by dorsal grooves. Genital segment much broader than the one-segmented abdomen, anal laminae longer than abdomen. Third leg long, steadily narrowing towards the apex, its surface minutely spiny. Fourth leg biramous, outer ramus much longer than inner, both rami spiny like the third leg.

Total length 1.9 mm.

Remarks. Yamaguti's description was based on a single female. The present specimens show slight difference in the shape of the frontal horns, structure of the distal segment of the second antenna, and in the length of the fourth leg. The second segment of the second antenna has a claw in addition to the small tooth shown by Yamaguti and the unguis is clearly marked off. The rami of the fourth leg are slightly longer and more conspicuously narrowed distally. In Yamaguti's specimen the anal laminae are visible beyond the dorsal plate but they are hidden in my specimens.

This species can be distinguished from all the others by the long horn-like antero-lateral lobes of the carapace, which have suggested the specific name, and the peculiar modification of the distal segment of the second antenna. The laterally produced diamond-shaped carapace of the male is also very characteristic.

Lernanthropus secutoris sp. nov.

Text-fig. 4

Material. 33 females were collected from the gills of *Secutor insidiator* (Bloch) by the author at Trivandrum. Holotype, female, is deposited in the Indian Museum, Calcutta (Reg. No. C. 4343/1).

Female. Body demarcated into three subequal parts, carapace, anterior division of trunk and dorsal plate. Carapace roughly triangular, narrowing backwards, antennal region demarcated by two shallow dorsal grooves, antero-lateral regions prominent and produced into rounded lobes not much folded downwards. Anterior division of trunk broader than long, demarcated from the dorsal plate by shallow lateral incisions. Dorsal plate slightly longer than broad, as broad as thorax and posteriorly rounded, anal laminae projecting beyond

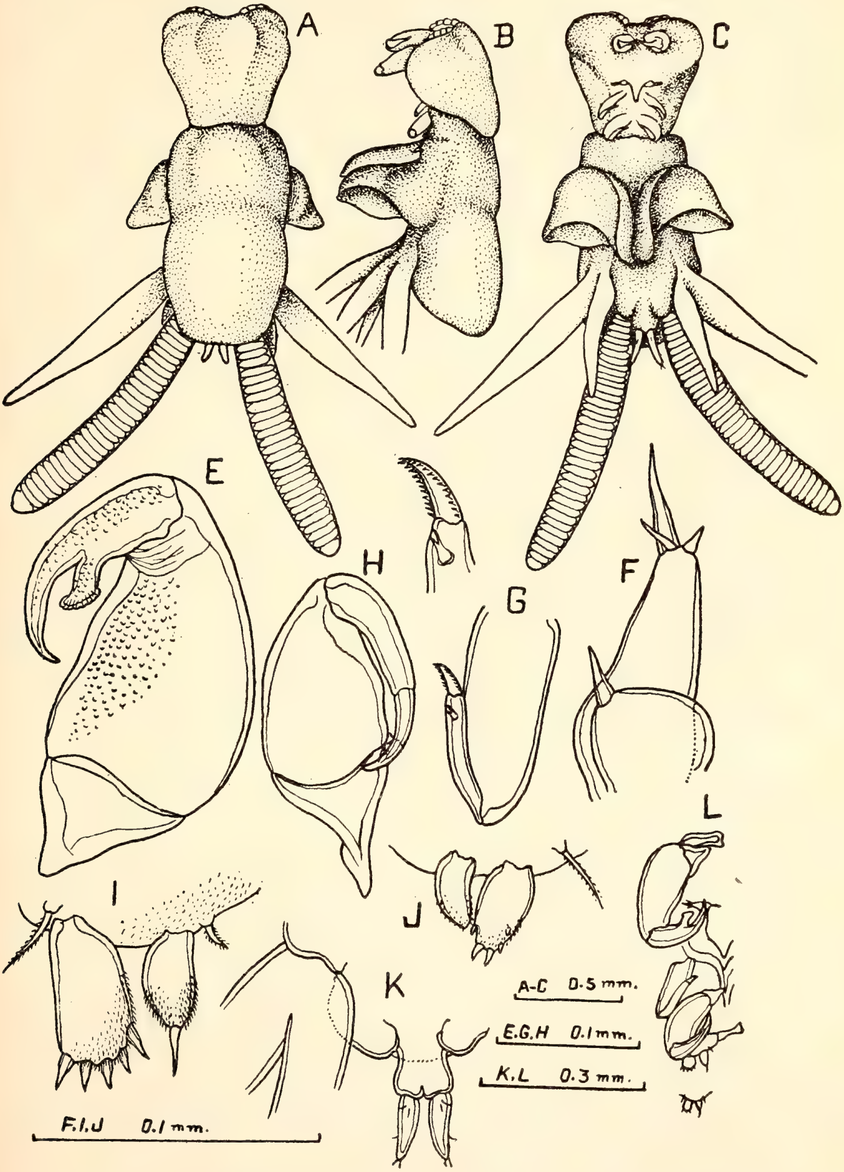

Fig. 4. *Lernanthropus secutoris* sp. nov.: Female. A. dorsal view; B. lateral view; C. ventral view; E. antenna 2; F. maxilla; G. maxilliped 1; H. maxilliped 2; I. leg 1; J. leg 2; K. posterior part of body; L. cephalic appendages

its posterior border. Genital segment very large, about three times as broad as abdomen. Egg sacs short and stout, with large eggs.

First antenna indistinctly seven-segmented. Second antenna with a large massive basal segment, its distal inner part pustulose, second segment strong and curved, with a large cylindrical and apically flared process at the middle of its inner side, obviously an extreme modification of the simple claw normally seen in this position. Inner lobe of maxilla with a sharp spine, outer lobe with a long spine and two short ones. First maxilliped with a stout basal segment, distal segment much shorter and narrower than basal, with a distal bifid claw, unguis with two rows of sharp teeth. Second maxilliped normal, with a slender strongly curved distal segment.

Exopod of first leg larger than endopod and armed with five sharp teeth and several small denticles, endopod denticulated and with a short apical spine. Second leg similar to first but smaller, endopod lacking the apical spine. Third leg uniramous, composed of two contiguously placed cups facing the posterior. Fourth leg biramous, exopod large, endopod half as long as exopod. Fifth leg absent. Anal laminae twice as long as abdomen.

Total length 1.3 mm.

Remarks. *L. secutoris* can be easily distinguished from all the other species by the triangular carapace narrowing backwards and by the oblong thorax. The egg tubes are unusually stout. The most distinctive character is the peculiar modification of the accessory claw on the distal segment of the second antenna, something even remotely resembling which is found only in *L. corniger* Yamaguti.

Lernanthropus otolithi sp. nov.

Text-fig. 5

Material. 34 females were collected from the gills of *Otolithus argenteus* Cuvier by the author at Trivandrum. Holotype, female, is deposited in the Indian Museum, Calcutta (Reg. No. C.4344/1).

Female. Body clearly divisible into carapace, trunk, and dorsal plate. Carapace roughly circular and anteriorly trilobed, antennal lobe broader and projecting beyond the lateral lobes. Anterior division of trunk cylindrical, with subparallel sides, dorsal plate circular in outline. Genital segment, abdomen, and anal laminae hidden by the dorsal plate, abdomen long and two-segmented, first segment longer and broader than second. Genital segment short but broader than abdomen. Anal laminae long and slender, with two apical and two outer setae.

First antenna clearly seven-segmented, accessory process at its base strongly curved and with swollen base. Second antenna with stout basal segment, distal segment short, with a basal inner spine.

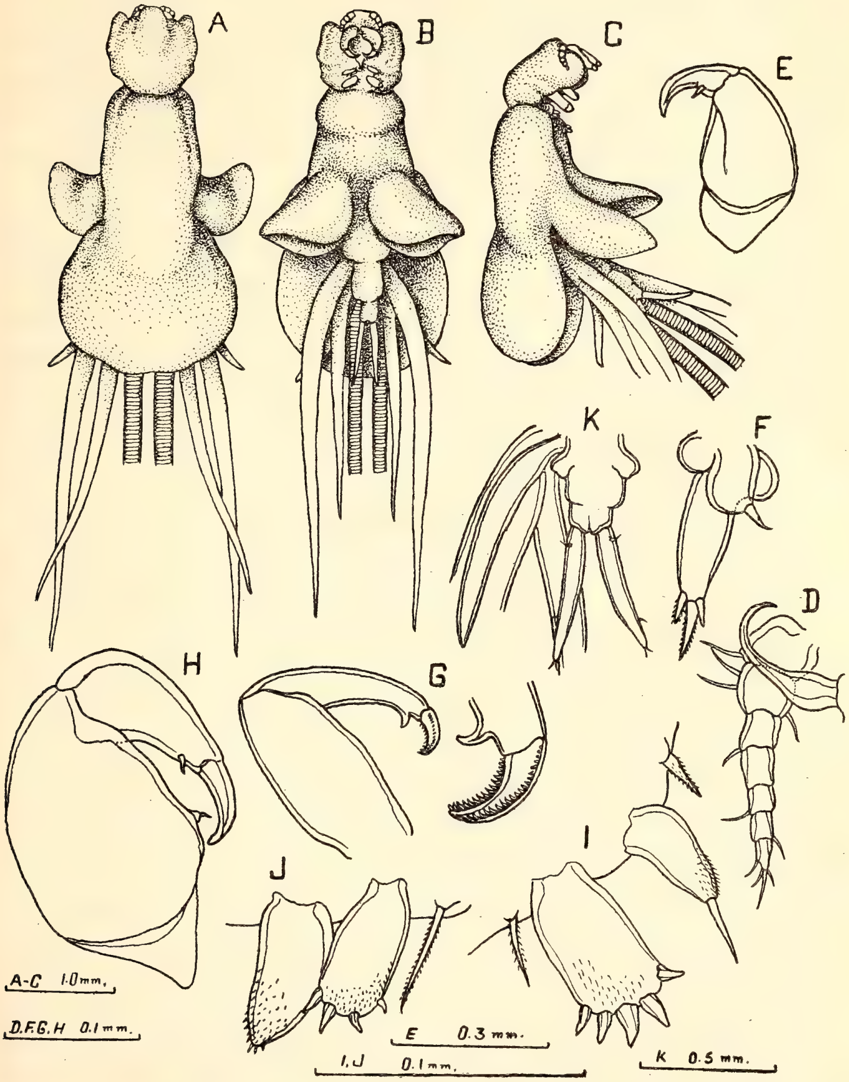

Fig 5. *Lernanthropus otolithi* sp. nov. : Female. A. dorsal view ; B. ventral view ; C. lateral view ; D. antenna 1 ; E. antenna 2 ; F. maxilla ; G. maxilliped 1 ; H. maxilliped 2 ; I. leg 1 ; J. leg 2 ; K. posterior part of body.

Inner lobe of maxilla small, with one spine, outer lobe long, with one long and two short spines. First maxilliped with segments subequal in length, distal segment with a strong claw-like accessory process below the unguis, unguis with prominent marginal teeth. Second maxilliped with a very stout basal segment, distal segment proximally expanded, unguis distinct.

First leg with outer and inner pectinate setae, exopod stout, with five teeth, endopod with a single apical spine, both rami sparsely spinose. Second leg without inner seta, exopod with four teeth, endopod without spine, rami subequal in size. Third leg with rami completely fused and folded lengthwise. Fourth leg biramous, long and slender, exopod longer than endopod. Fifth leg uniramous, about half as long as the endopod of the fourth leg.

Total length 3.0 mm.

Remarks. This species shows the closest resemblance to *L. gisleri* van Beneden (1852) as described by Yamaguti (1936), which like the present is a parasite of sciaenid fishes. Both have the same type of carapace and trunk but in *L. otolithi* the dorsal plate is nearly circular while it is roughly parallel-sided in *L. gisleri.* Also in *L. otolithi* the exopod of the fourth leg is much longer than the endopod, but almost subequal in *L. gisleri.*

Lernanthropus sillaginis sp. nov.

Text-fig. 6

Material. 41 females were collected from the gills of *Sillago sihama* (Forskal) by the author at Trivandrum. Holotype, female, is deposited in the Indian Museum, Calcutta (Reg. No. C. 4345/1).

Female. Body stout, carapace nearly rounded, with distinctly demarcated antennal area, lateral parts forming prominent ventrally directed flaps projecting beyond the antennal area as small triangular lobes. Anterior part of trunk regularly widening backwards, as long as the carapace. Dorsal plate large, transversely expanded and roughly ovate, with evenly convex posterior border. Genital segment small, abdomen longer than broad, anal laminae slightly shorter than abdomen.

First antenna distinctly seven-segmented, with a few stout setae, fifth segment with a long stout seta, first segment large, seventh small. Basal segment of second antenna comparatively slender, with a proximal and a distal tubercle carrying a spinule, distal segment with a swollen base carrying a claw-like spine. Maxilla with a small inner and large swollen outer lobe, latter with one large and one small distal spine. First maxilliped slender, distal segment with a small spine, unguis with serrate edge. Second maxilliped with a comparatively very stout basal segment with one papilla, distal segment slender, with two spines, unguis very distinct.

First leg with large exopod carrying five spines, endopod oblong, with a long spine. Exopod of second leg with five spines, three of them very small, endopod considerably larger than exopod, with a slender seta. Third leg distinctly biramous, rami foliaceous, exopod folded over the linguiform endopod. Fourth leg comparatively short, with subequal rami, half of the rami projecting beyond the dorsal plate. Eggs comparatively large.

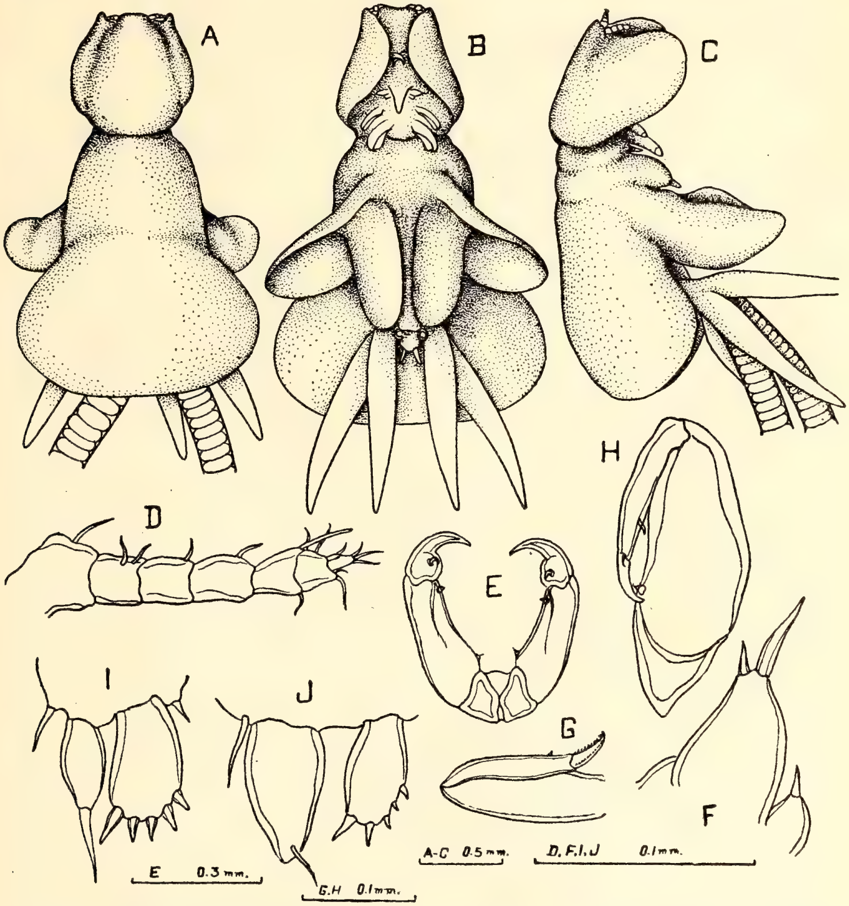

Fig. 6. *Lernanthropus sillaginis* sp. nov.: Female. A. dorsal view; B. ventral view; C. lateral view; D. antenna 1; E. antenna 2; F. maxilla; G. maxilliped 1; H. maxilliped 2; I. leg 1; J. leg 2.

Total length 2.5 mm.

Remarks. In general appearance and in the structure of the appendages this species resembles *L. villiersi* Delamare-Douboutteville & Nunes-Ruivo (1954), but in the latter species the dorsal plate has a very distinct postero-median incision and the endopods of the third pair of legs are fused. In *L. sillaginis* the dorsal plate has an entire posterior border and the endopods of the third pair of legs are completely free.

Lernanthropus triangularis sp. nov.

Text-fig. 7

Material. 2 females and 1 male were collected from the gills of *Gerres filamentosus* Cuvier by the author at Trivandrum. Holotype (Reg. No. C. 4346/1), female and allotype (Reg. No. C. 4347/1), male, are deposited in the Indian Museum, Calcutta.

Female. General shape of body elongate-triangular. Carapace triangular, with the postero-lateral parts slightly produced, making the posterior border concave. Antennal area fairly broad, antero-lateral parts hardly produced. Anterior division of trunk regularly broadening backwards, demarcated from the dorsal plate by a distinct lateral incision and indistinct dorsal transverse grooves. Dorsal plate nearly rectangular, broader than anterior part of trunk, its posterior border nearly straight. Genital segment large, abdomen short. Anal laminae as long as abdomen, with one distal and two proximal setae.

First antenna distinctly seven-segmented, sparsely setose, accessory process at its base long and apically slightly curved. Second antenna comparatively slender, distal segment stout, with a claw and a spine, apical part of the segment strongly curved. Maxilla two-lobed, inner lobe with one and outer with three spines. Distal segment of first maxilliped with a very small tooth and a spine, unguis with serrate border. Basal segment of second maxilliped very stout, distal segment slender, with two spines on the inner border, unguis long.

Basipod of first leg with both inner and outer setae, exopod larger than endopod, with five subsimilar teeth, endopod spiny, with a long apical spine. Second leg with subequal spiny rami, exopod with four teeth, endopod with a very small spine seta. Third leg small, rami partially fused, exopod facing forwards and endopod backwards. Fourth leg biramous, reaching beyond the dorsal plate by about half their length, exopod slightly longer than endopod. Fifth leg absent.

Total length 2.4 mm.

Male. Body subcylindrical, carapace ovate, narrower in front, antennal area slightly indicated. Trunk demarcated into four indistinct thoracic segments, genital segment and abdomen partially fused. First antenna prominently setose. Second antenna slender and very long, strongly prehensile. Third leg biramous, endopod indicated by a mere lobe. Fourth leg twice as long as third, endopod half as long as exopod.

Total length 2.4 mm.

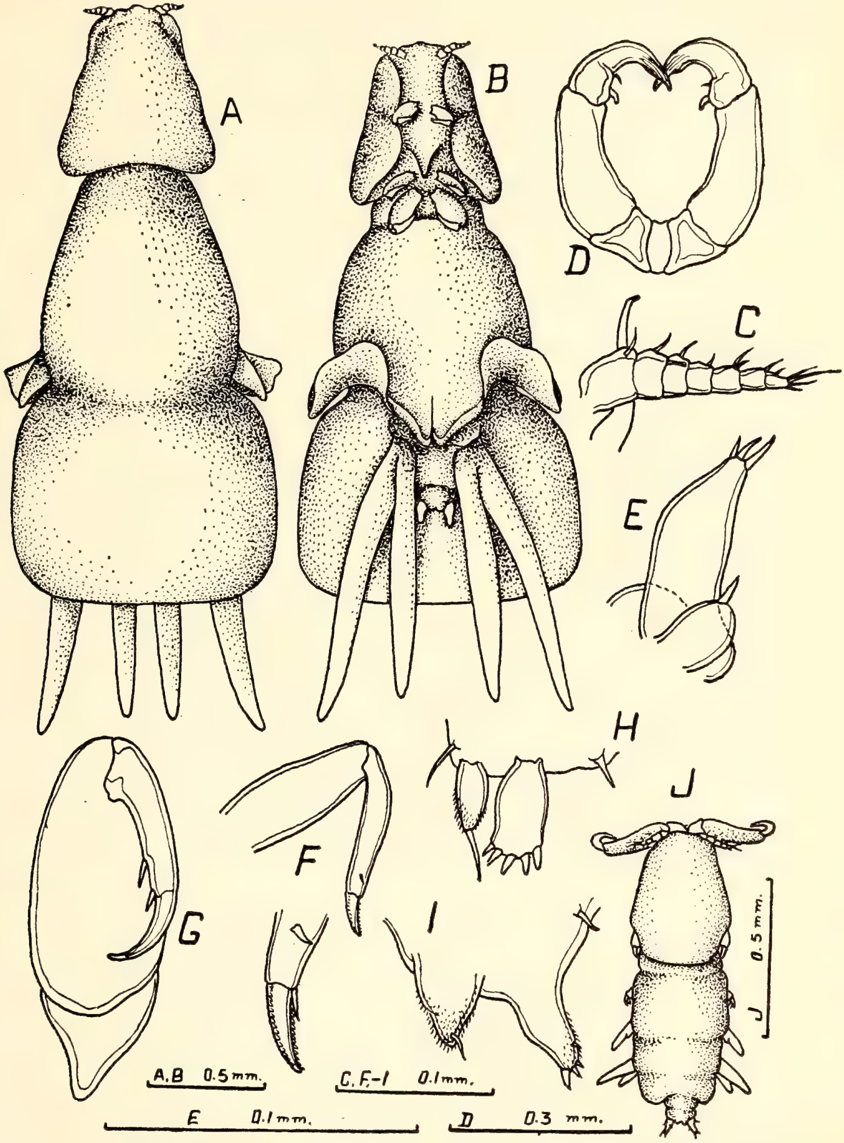

Fig. 7. *Lernanthropus triangularis* sp. nov.: A-I. female: A. dorsal view; B. ventral view; C. antenna 1; D. antenna 2; E. maxilla; F. maxilliped 1; G. maxilliped 2; H. leg 1; I. leg 2. J. male

Male. Body subcylindrical, carapace ovate, narrower in front, antennal area slightly indicated. Trunk demarcated into four indistinct thoracic segments, genital segment and abdomen partially fused. First antenna prominently setose. Second antenna slender and very long, strongly prehensile. Third leg biramous, endopod indicated by a mere lobe. Fourth leg twice as long as third, endopod half as long as exopod.

Total length 0.9 mm.

Remarks. This species shows a superficial resemblance to *L. sciaenae* Gnanamuthu (1947). In the latter species the fifth leg, which Gnanamuthu seems to have mistaken for a third ramus of the fourth leg, is present but absent in *L. triangularis*. Because of the lack of details further comparison is difficult.

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More Cyanophyceae of Hoshiarpur: II

BY

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(*With two plates*)

[*Continued from Vol.* **58**(1) : 146]

In the first two papers on the systematics of Cyanophyceae of Hoshiarpur [*J. Bombay nat. Hist. Soc.* **57** (3) and **58**(1)] the author described 73 species belonging to 28 genera, including two new species, two new varieties, and seven new forms. The present paper which is the third in the series further adds to our knowledge of the blue-green algae of Hoshiarpur, and 41 species belonging to 17 genera have been recorded herein. This brings the total to 114 species belonging to 32 genera. Six new varieties have been included in the present work.

Phormidium mucosum Gardner, *P. hieronymusii* Lemm., *Scytonema millei* Bornet, and *Microchaete tenera* var. *major* Moebius have been, to the best of author's knowledge, reported for the first time from the Indian soil.

Cyanophyceae described in the present paper have been mainly collected from freshwater and terrestrial habitats. Freshwater forms are important as lithophytes and epiphytes, whereas some live in or on the bottom of deep or shallow water ponds. There are a limited number of Cyanophyceae that constitute a conspicuous element of the plankton at different times of the year. Some of the lithophytes grow commonly in fast flowing streams.

SYSTEMATIC ENUMERATION OF THE SPECIES OBSERVED

Order CHROOCOCCALES Wetstein

Family CHROOCOCCACEAE Nägeli

CHROOCOCCUS Nägeli

1. **Chroococcus minor** (Kütz.) Näg. Gatt. Einzell. Algen 47, pl. 1 A, fig. 4, 1849; Desikachary, Cyanophyta 105, pl. 24, fig. 1, 1959.

Diameter cell without sheath = 3-3.4 μ; diameter cell with sheath = up to 4.3 μ.

Habitat: Mixed with other algae in a stagnant water pond situated by the side of a railway track near village Singriwala, Hoshiarpur.

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2. **Chroococcus limneticus** Lemm. in Bot. Cbl. 76 : 153, 1898 ; Desikachary 107, pl. 26, fig. 2, 1959.

Diameter cell without sheath=6.6-10.5 μ ; diameter cell with sheath=7.6-12.1 μ ; cells spherical or sub-spherical, 16-32 in a colony.

Habitat : Planktonic in an old tank at Bhadarpur, Hoshiarpur. Mixed with *Synechococcus cedrorum* Sauv.

GLOEOCAPSA Kützing

3. **Gloeocapsa quaternata** (Breb.) Kütz. Tab. Phycol. 1 : 5, pl. 20, fig. 1, 1846 ; Desikachary 120, pl. 20, fig. 9, 1959.

Diameter cell without sheath=3.4-4.7 μ ; diameter cell with sheath=7.6-11.5 μ ; diameter colony=11.5-19.2 μ ; sheath usually red, sometimes colourless, cells 2-4-8 in a colony.

Habitat : Forming blackish green encrustation on tree trunks, Hoshiarpur.

4. **Gloeocapsa violacea** (Corda) Rabenh. Fl. Eur. Alg. 2 : 41, 1865 ; Desikachary 123, 1959.

Diameter cell without sheath=3.4-3.8 μ ; diameter cell with sheath=9.5-13.4 μ ; diameter colony=76.8-102.1 μ ; sheath violet and unlamellated.

Habitat : On the moist stones of a rivulet at Bharwain, Hoshiarpur.

5. **Gloeocapsa sanguinea** (Ag.) Kütz. Phyc. Gen. 175, 1843 ; et Tab. Phyc. 1 : pl. 22, 1846 ; Desikachary 121, pl. 27, fig. 7, 1959.

Diameter cell without sheath=3.8-6.6 μ ; diameter cell with sheath=7.6-11.5 μ ; diameter colony=38.4-46 μ.

Habitat : Mixed with *G. quaternata* Kütz., Hoshiarpur.

6. **Gloeocapsa kuetzingiana** Näg. Gatt. Einzell. Algen 50, 1849 ; Desikachary 118, pl. 23, fig. 4 & pl. 24, fig. 12, 1959.

Diameter cell without sheath=3.8-4.7 μ ; diameter cell with sheath=5.7-7.6 μ ; diameter colony=38.4-76.8 μ ; sheath yellowish brown and unlamellated.

Habitat : Forming blue-green to brownish encrustation on bricks and stones at the bottom of an irrigation channel passing through village Rihana, Hoshiarpur.

MERISMOPEDIA Meyen

7. **Merismopedia aeruginosa** Breb. in Kützing, Spec. Alg. 472, 1849 ; Desikachary 156, pl. 20, fig. 3, 1959.

Lat. colony=34.5-50 μ ; lat. cell=4.7-5.1 μ.

Habitat : In a roadside pond, Phagwara road, Hoshiarpur.

SYNECHOCYSTIS Sauv.

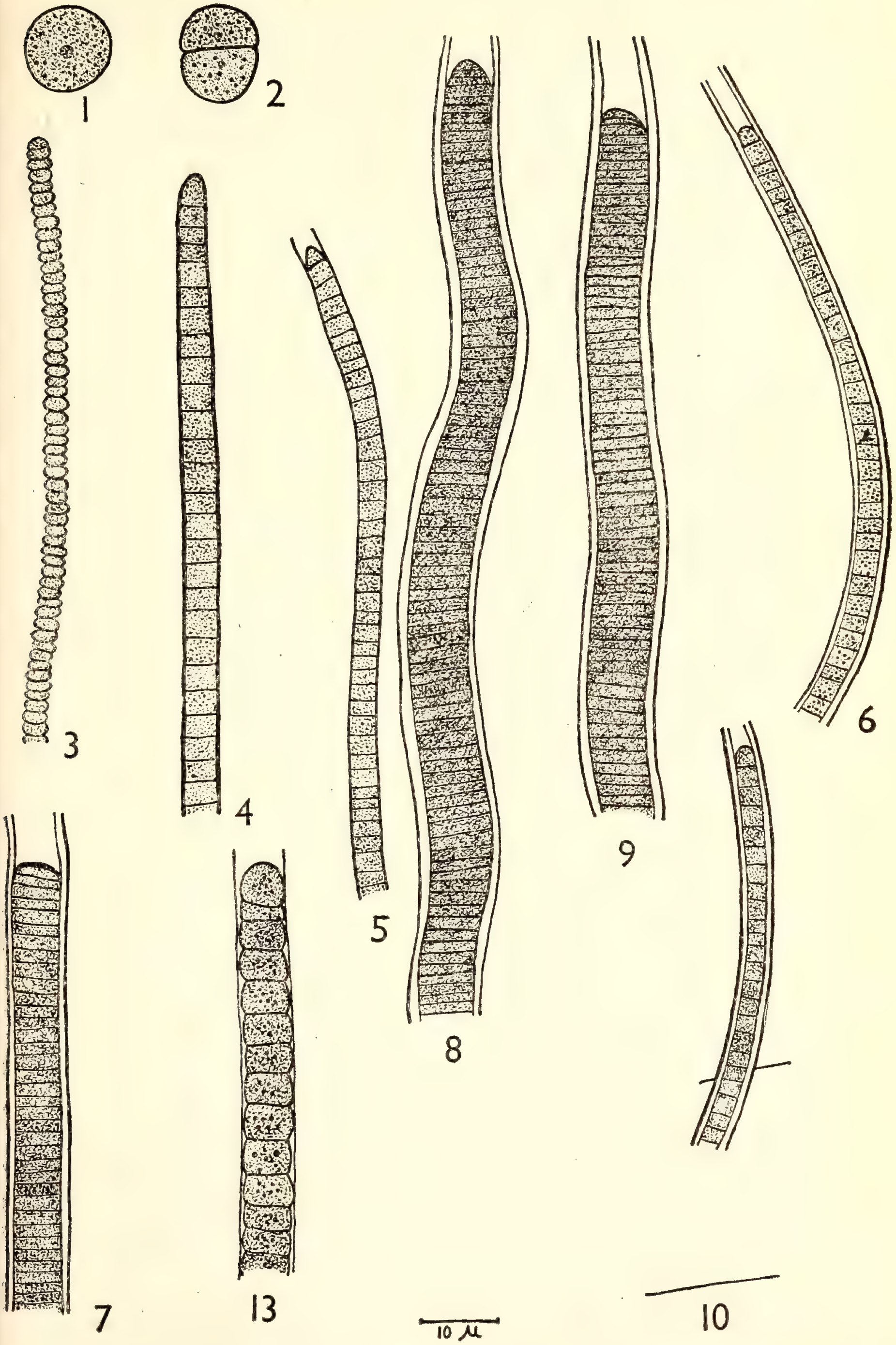
8. **Synechocystis aquatilis** Sauv. var. **major** var. nov. (Plate I, Figs. 1-2)

Cellulae sphaericae, 7.6-8.5 μ diam., singulae vel binae immediate post divisionem ; contenta caeruleo-viridia, granularia. Typus lectus 8 junii, 1960, et positus in Hoshiarpur herbario Collegii Gubernii sub numero *Vasishta* 10.

Cells spherical, 7.6-8.5 μ diam., single or in twos after division, contents blue-green, granular.

Habitat : Planktonic in a stagnant water pond, Phagwara road, Hoshiarpur. Collected on June 8, 1960. Deposited in Government College, Hoshiarpur herbarium under reference number *Vasishta* 10.

The variety differs from the type in possessing the greater dimensions of the cell.



Figs. 1-2. *Synechocystis aquatilis* var. *major* var. nov. : Fig. 1. A single cell; Fig. 2. A cell after division. Fig. 3. *Oscillatoria foreaui* Fremy. : A portion of the trichome. Fig. 4. *Oscillatoria subuliformis* Kütz. ex Gom. : Portion of the trichome. Fig. 5. *Phormidium rubroterricola* var. *majus* var. nov. : Portion of the filament. Fig. 6. *Phormidium mucosum* Gardner : Portion of the filament. Fig. 7. *Phormidium stagninum* var. *minus* var. nov. : Portion of the filament. Figs. 8-9. *Phormidium hieronymusii* Lemm. : Portions of two filaments. Fig. 10. *Lyngbya kuetzingii* Schmidle. : Portion of the filament. Fig. 13. *Lyngbya cryptovaginata* Sch. : Portion of the filament

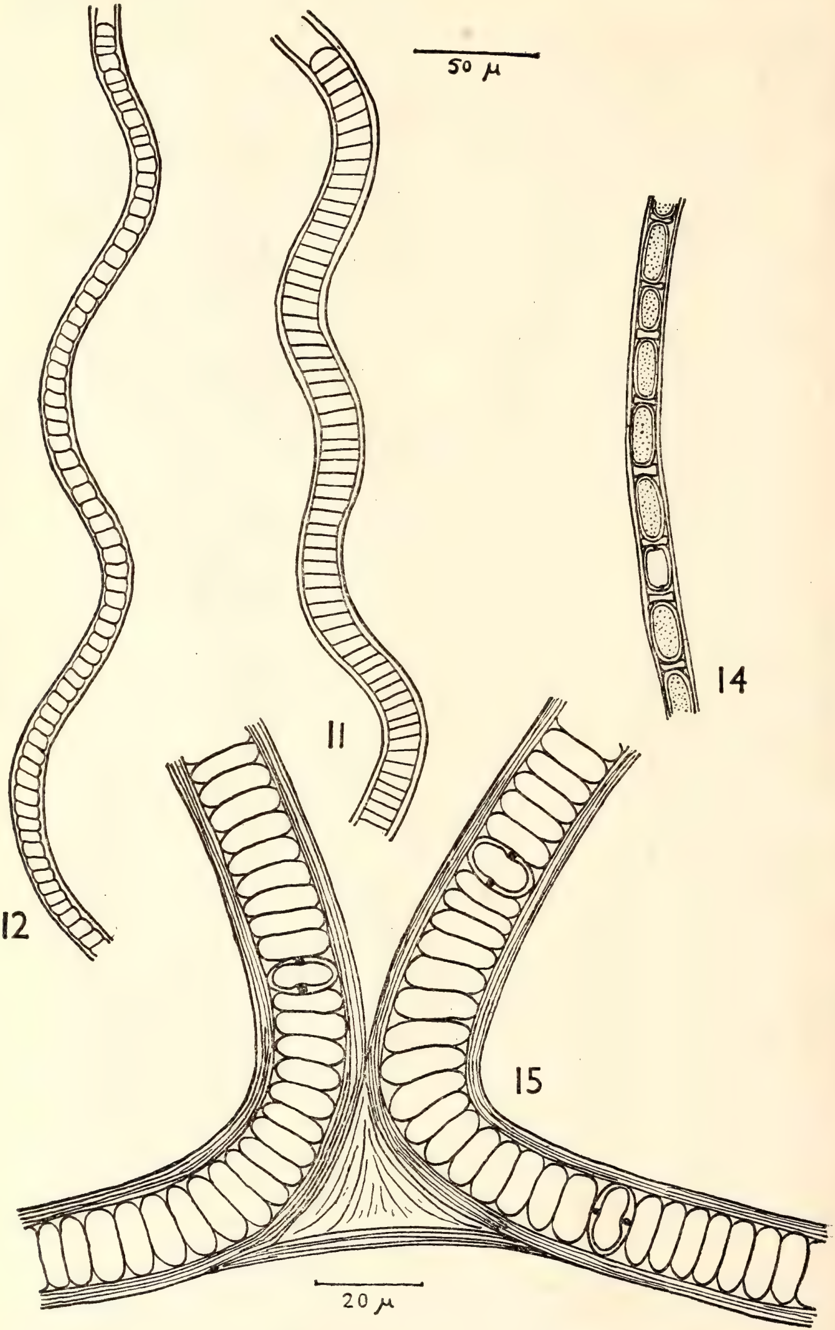


Fig. 11. *Lyngbya spirulinoides* var. *minor* var. nov. : Portion of a filament. Fig. 12. *Lyngbya laxespiralis* var. *major* var. nov. : Portion of the filament. Fig. 14. *Aulosira fertilissima* var. *hoshiarpurensis* var. nov. : Portion of a fertile filament showing series of spores interrupted by dead cells. Fig. 15. *Scytonema millei* Bornet ex Born. et Flah. : A portion of the filament showing false branches.

SYNECHOCOCCUS Näg.

9. **Synechococcus cedrorum** Sauv. in Bull. Soc. Bot. France 39 : 115, pl. 6, fig. 1, 1892 ; Desikachary 144, 1959.

Lat. cell=3.4-4.2 μ ; long. cell=6.6-8.5 μ.

Habitat : Planktonic in an old tank, Bhadarpur, Hoshiarpur. Mixed with *Chroococcus limneticus* Lemm.

Order **PLEUROCAPSALES** Geitler

Family **PLEUROCAPSACEAE** Geitler

MYXOSARCINA Printz.

10. **Myxosarcina spectabilis** Geitler in Arch. Hydrobiol. 12 : 624, 1933 ; et 14 : 387, fig. 14, 1935-36 ; Desikachary 178, pl. 30, figs. 1-5, pl. 31, figs. 17-22, 1959.

Diameter cell=5.7-8.5 μ ; diameter endospore=3.8-4.7 μ.

Habitat : Forming a deep blue-green thallus on tree trunks, Hoshiarpur.

Order NOSTOCALES Geitler

Family **OSCILLATORIACEAE** Kirchner

SPIRULINA Turpin ex Gardner

11. **Spirulina gigantea** Schmidle in Bot. Jahrb. 32 : 59, pl. 1, fig. 5, 1902 ; Desikachary 197, pl. 36, figs. 12, 14-17, 1959.

Lat. trichome=3.8-4 μ ; breadth of spiral=11.3-15.3 μ ; spirals 7.6-11.3 μ distant.

Habitat : Among other algae in a pond, Hoshiarpur.

OSCILLATORIA Vaucher

12. **Oscillatoria princeps** Vauch. [Hist. Conf. Eau Douc. 190, pl. 15, fig. 2, 1803] ex Gomont, Monograph Oscill. 206, pl. 6, fig. 9, 1892 ; Desikachary 210, pl. 37, figs. 1, 10, 11, 13, 14, 1959.

Lat. trichome=26.8-49.9 μ ; long. cell=5.7-7 μ.

Habitat : In slowly running water of a watercourse at Una, Hoshiarpur.

13. **Oscillatoria formosa** Bory [Dict. Class. Hist. Nat. 12 : 474, 1827] ex Gomont, loc. cit. 230, pl. 7, fig. 16, 1892 ; Desikachary 232, pl. 40, fig. 15, 1959.

Lat. trichome=4-6.6 μ ; long. cell=3.8-5.1 μ.

Habitat : Forming a blue-green thallus attached to the walls of a water reservoir, Government College, Hoshiarpur.

14. **Oscillatoria animalis** Ag. [Aufzah. Fl. 10 : 632, 1827] ex Gomont 227, pl. 7, fig. 13, 1892 ; Desikachary 239, pl. 40, fig. 4, 1959.

Lat. trichome=3.4-4 μ ; long. cell=1.7-3.4 μ.

Habitat : Forming a blue-green thallus at the bottom of a pond at village Purhiran, Hoshiarpur.

15. **Oscillatoria foreaui** Fremy in Blumea, Suppl. II : 23, fig. 2, 1942 ; Desikachary 219, pl. 40, fig. 18, 1959. (Plate I, Fig. 3)

Lat. trichome=2.5-3 μ ; long. cell=1.5 μ ; trichomes constricted at the joints.

Habitat : From the bottom of a pond, village Purhiran, Hoshiarpur.

16. **Oscillatoria amphigranulata** Van Coor in Rev. Trav. Bot. Neerl. 15 : 255, pl. 2, fig. 2, 1918 : Desikachary 226, pl. 37, fig. 4, 1959.

Lat. trichome=2-3 μ; long. cell=4.7-5.1 μ; one vacuole on either side of the septum.

Habitat : Planktonic in a pond situated by the side of a railway track near village Singriwala, Hoshiarpur.

17. **Oscillatoria mougeotii** Kütz. [Tab. Phycolog. 1 : 30, pl. 41, fig. 10, 1849] ex Desikachary 222, 1959.

Lat. cell=5.1-8.5 μ ; long. cell=3.4-4.2 μ ; gas vacuoles present.

Habitat : Planktonic in a pond, village Singriwala, Hoshiarpur.

18. **Oscillatoria subuliformis** Kütz. [in Oster-progress. 7, 1863] ex Gomont 226, pl. 7, fig. 10, 1892 ; Desikachary 213, pl. 49, fig. 10, 1959. (Plate I, Fig. 4)

Lat. trichome=4.7-6.6 μ ; long. cell=4.7-6.6 μ.

Habitat : Forming a pale yellow or yellowish green thallus attached to *Hydrilla* plants in a pond, Hoshiarpur.

PHORMIDIUM Kützing

19. **Phormidium fragile** (Menegh.) Gomont, loc. cit. 163, pl. 4, figs. 13-15, 1892; Desikachary 253, pl. 44, figs. 1-3, 1959.

Lat. trichome=1.7-2.5 μ ; long. cell=1.7-3.4 μ.

Habitat : On the walls of Botanical tank, Government College, Hoshiarpur.

20. **Phormidium molle** (Kütz.) Gomont 163, pl. 4, fig. 12, 1892; Desikachary 255, pl. 59, fig. 8, 1959. Forma **tenuior** W. & G. S. West in Bot. Trans. York. nat. Union 5 : 146, 1902.

Lat. trichome=2-2.7 μ ; long. cell=2.7-3.8 μ.

Habitat : Forming a thin, mucilaginous and light blue-green thallus on the sides of Botanical tank, Government College, Hoshiarpur.

21. **Phormidium rubroterricola** Gardner var. **majus** var. nov. (Plate I, Fig. 5)

Trichomata 2.5-3.4 μ lata, non constricta ad septa. Cellulae 1.7-3.4 μ longae; cellula terminalis conica; vagina distincta. Positus in Government College, Hoshiarpur herbario sub numero *Vasishta* 17.

Trichomes 2.5-3.4 μ broad, not constricted at the septa ; cells 1.7-3.4 μ long ; end cell conical; sheath distinct.

Habitat : In crop field soil cultures, Botanical laboratory, Government College, Hoshiarpur, September 15, 1960. Deposited in Government College, Hoshiarpur herbarium under reference number *Vasishta* 17.

The variety differs from the type in possessing broader filaments and trichomes.

22. **Phormidium mucosum** Gardner in Mem. N. Y. Bot. gard. 7 : 43, pl. 9, fig. 84, 1927 ; Desikachary 265, p. 43, figs. 6, 7, 1959. (Plate I, Fig. 6)

Lat. trichome=2.7-3.4 μ ; long. cell=3.4-5.1 μ ; lat. filament=4.8-6.7 μ ; crass. vag.=0.85-1.7 μ.

Habitat : From the inner sides of a water pipe, Government College, Hoshiarpur. The type is being reported for the first time from the Indian soil.

23. **Phormidium stagninum** Rao var. **minus** var. nov. (Plate I, Fig. 7)

Thallus caeruleo-viridis vel pallide viridis ; filamenta longa, recta vel curvata, 8.5-9.5 μ lata ; trichomata non constricta, pallide caeruleo viridia, 6.8-7.6 μ lata ; vaginae hyalinae, firmae, distinctae ; cellulae 1.7-2 μ longae ; cellula terminalis late rotundata ;

calyptra adest. Typus lectus mense maio 31, 1960, et positus in Hoshiarpur Collegio Gubernii sub numero *Vasishta* 11.

Thallus blue-green or pale green, mucilaginous ; filaments long, straight or curved, 8.5-9.5 µ broad ; trichomes unconstricted, pale blue-green, 6.8-7.6 µ broad ; sheath hyaline, firm, distinct ; cells small, 1.7-2 µ long ; end cell broadly rounded ; calyptra present.

Habitat : On the inner sides of a water pipe, Government College, Hoshiarpur, May 31, 1960. Deposited in Government College, Hoshiarpur herbarium under reference number *Vasishta* 11.

The variety differs from the type in possessing narrower filaments and trichomes.

24. **Phormidium ambiguum** Gomont 178, pl. 5, fig. 10, 1892 ; Desikachary 266, pl. 44, fig. 16 & pl. 45, figs. 5-8, 1959.

Lat. trichome=4.7-6.6 µ ; long. cell=3-3.4 µ.

Habitat : On moist soil, village Purhiran, Hoshiarpur.

25. **Phormidium corium** (Ag.) Gomont 172, pl. 5, figs. 1-2, 1892 ; Desikachary 269, pl. 44, figs. 10-11, 1959.

Lat. trichome=3.8-4.7 µ ; long. cell=3-8-7.6 µ.

Habitat : On stones in swiftly flowing water of a rivulet at Dholbaha, Hoshiarpur.

26. **Phormidium hieronymusii** Lemm. in Ark. Bot. 2 : 104, 1903, et Abh. Nat. Ver. Bremen 14 : 259, pl. 1, figs. 5-7, 1934 ; Desikachary 269, 1959. (Plate I, Figs. 8-9)

Thallus olive-green to yellowish brown ; filaments usually regularly spirally coiled, 8.5-10.2 µ broad ; sheath distinct, firm, thin or thick, not lamellated, not coloured violet by chlor-zinc-iodide ; trichomes not constricted, slightly attenuated at the ends, blue to yellowish green, 6.8-7.6 µ broad ; cells very short, 1.72 µ long ; cross walls sometimes granulated ; end cell rounded, rarely slightly capitate.

Habitat : On the moist sides of a hillock at Dholbaha, Hoshiarpur. The type is being recorded for the first time from the Indian soil.

LYNGBYA Agardh

27. **Lyngbya lachneri** (Zimm.) Geitler, Kryptogamenfl. 1037, fig. 655, 1932 ; Desikachary 281, 1959. *Oscillatoria lachneri* Zimm. in Zeitschr. Bot. 20 : 18, pl. ld, II e, 1928.

Lat. trichome=1.9-3.4 µ ; long. cell=1.7-3.4 µ.

Habitat : Attached to the leaf segments of *Utricularia*, Hoshiarpur.

28. **Lyngbya kuetzingii** Schmidle in Allg. Bot. Zeutschr. 58, 1896 ; Desikachary 282, pl. 48, fig. 2, 1959. (Plate I, Fig. 10)

Long. filament=38.4-76.8 µ; lat. trichome=1.7-2.5 µ ; long. cell=0.85-1.5 µ.

Habitat : On *Spongomorpha* sp. in a watercourse near village Sham Chaurasi, Hoshiarpur.

29. **Lyngbya spirulinoides** Gomont var. **minor** var. nov. (Plate II, Fig. 11)

Filamenta laxe spiraliter curvata, libere natantia, singula, 12.4-15.3 µ lata ; vagina tenuis, indistincte lamellata ; trichomata non-constricta, 10.5-11.3 µ lata ; spiris 76.8-107 µ distantibus ; septa nongranulata ; cellulae 3.4-4.7 µ longae ; cellula terminalis rotunda ; calyptra nulla. Positus in Government College, Hoshiarpur herbario sub numero *Vasishta* 12.

Filaments loosely spirally coiled, free floating, single, 12.4-15.4 µ broad ; sheath thin, indistinctly lamellated ; trichomes unconstricted, 10.5-11.3 µ broad ; spirals

76.8-107 μ distant: septa not granulated: cells 3.4-4.7 μ long; end cell round; calyptra absent.

Habitat: Free floating in a tank containing *Utricularia* sp., Hoshiarpur. Collected in October 12, 1959. Deposited in Government College, Hoshiarpur herbarium under reference number *Vasishta* 12.

The variety differs from the type in possessing narrower filaments and trichomes.

30. **Lyngbya laxespiralis** Skuja var. **major** var. nov. (Plate II, Fig. 12)

Filamenta spiraliter curvata, 11.5-12.1 μ lata; vagina tenuis, firma, incolora, non-lamellata; trichomata constricta, 9.5-11.5 μ lata; cellulae 5.7-7.6 μ longae; contenta granularia, caeruleo-viridia; parietes transversi non-granulati; cellula apicalis rotundata; spiris 100-115 μ distantibus. Positus in Government College, Hoshiarpur herbario sub numero *Vasishta* 13.

Filaments spirally coiled, 11.5-12.1 μ broad; sheath thin, firm, colourless, unlamellated; trichomes contricted, 9.5-11.5 μ broad; cells 5.7-7.6 μ long, cell contents granular, blue-green, cross walls not granulated; apical cell rotund; spirals 100-115 μ distant.

Habitat: Among other algae on moist soil, Hoshiarpur. Collected on September 20, 1960. Deposited in Government College, Hoshiarpur herbarium under reference number *Vasishta* 13.

The variety differs from the type in possessing broader filaments and trichomes.

31. **Lyngbya cryptovaginata** Schkorb. in Arch. Russ. Protistologia 6(-4): 125, pl. 8, figs. 14-16, 1927: Desikachary 297, pl. 50, fig. 6, 1959. (Plate I, Fig. 13)

Filaments single, free floating, straight or curved, 7.6-8.5 μ broad; sheath colourless; trichomes constricted, 6.6-7.6 μ broad, blue-green; cells quadratic or up to ½ as long as broad, 3.8-5.7 μ long; contents granular, pseudovacuoles present; end cell round.

Habitat: In water course, village Sham Chaurasi, Hoshiarpur.

MICROCOLEUS Desmaziers

32. **Microcoleus sociatus** West et West in Jour. Bot. Lond. 35: 272, 1897; Desikachary 346, 1959.

Lat. trichome=2.7-3.4 μ; lat. filament=38.4-76.8 μ; long. cell=3.8-7.6 μ.

Habitat: On moist soil, village Purhiran, Hoshiarpur.

Family NOSTOCACEAE Kützing

Subfamily ANABAENOIDEAE

CYLINDROSPERMUM Kützing

33. **Cylindrospermum licheniforme** Kütz. [in Bot. Zeitung, 5: 197, 1847; Tab. Phycol. 1: 53, pl. 98, fig. 6, 1849] ex Born. et Flah. Rev. Nostoc. Heterocyst. 253, 1888; Desikachary 366, pl. 65, fig. 8, 1959.

Lat. trichome=3.4-4.2 μ; long. cell=3.4-5.1 μ; lat. heterocyst=4.7-6.6 μ; long. heterocyst=7.6-11.5 μ; lat. spore=11.5-15.3 μ; long. spore=19.2-30.7 μ.

Habitat: Free floating in a stagnant water tank at Bhadarpur, Hoshiarpur.

NOSTOC Vaucher

34. **Nostoc spongiaeforme** Ag. [Syst. Alg. 22, 1824] ex Born. et Flah. Rev. Nostoc. Heterocyst. 197, 1888; Desikachary 380, 1959.

Lat. trichome=3.8-4 μ; long. cell=5.7-7.6 μ; lat. heterocyst=5.7-7.6 μ; long. heterocyst=7.6-9.5 μ; lat. spore=6.6-7.6 μ; long. spore=7.6-10.5 μ.

Habitat : Floating in a stagnant water pond, Phagwara road, Hoshiarpur.

var. **tenue** Rao in Proc. Indian Acad. Sci. 3 : 170, Fig. 2 F, 1936.

Lat. trichome=3.4-3.8 μ ; long. cell=3.8-5.7 μ ; lat. heterocyst=4.7-6.6 μ ; long. heterocyst=5.7-9.5 μ ; lat. spore=4.7-6.6 μ ; long. spore=5.7-9.5 μ.

Habitat : On moist soil, Guru Nanak Nagar, Hoshiarpur.

ANABAENA Bory

35. **Anabaena iyengarii** Bharadwaja in Proc. Indian Acad. Sci. B, 2 : 105, fig. 6 H-K, 1935 ; Desikachary 406, pl. 78, fig. 2, 1959.

Lat. trichome=5.6-6.6 μ ; long. cell=3.8-4.7 μ ; lat. heterocyst=7.6-8.5 μ ; long. heterocyst=7.6-8.5 μ ; lat. spore=9.5-11.5 μ ; long. spore=11.5-19.2 μ.

Habitat : Floating on the surface of water, Dholbaha, Hoshiarpur.

36. **Anabaena vaginicola** Fritsch et Rich. forma **fertilissima** Prasad in Journ. Indian Bot. Soc. 31 : 361, figs. 14-17, 1952 ; Desikachary 401, pl. 73, fig. 3, 1959.

Lat. filament=11.2-15 μ ; lat. trichome=4.6-5.6 μ ; long. cell=3.7-7.5 μ ; lat. heterocyst=5.6-7.5 μ ; long. heterocyst=7.5-12.1 μ ; lat. spore=4.6-8 μ ; long. spore =5.6-11.2 μ.

Habitat : In stagnant water of a crop field, Phagwara road, Hoshiarpur.

Subfamily AULOSIRAE Born. et Flah.

AULOSIRA Kirchener

37. **Aulosira fertilissima** Ghose var. **hoshiarpurensis** var. nov. (Plate II, Fig. 14)

Plantarum massae fibrosae, luteolo-brunneae vel luteolo-virides ; trichomata recta vel paulum flexuosa, 5.7-7.6 μ lata ; vaginae crassae, firmae ; filamenta 7.6-10.4 μ lata ; cellulae doliiformes vel cylindricae, 4-11.5 μ longae, contentis granularibus ; ramis falsis brevibus ; heterocysta intercalaria, 5.7-8.5 μ lata, 11.5-13.4 μ longa, oblonga vel elliptica ; sporae seriatae, ubique alternantes cellulis mortuis, 9.5-11.5 μ latae, 15.3-19.2 μ longae, oblongae vel ellipticae. Positus in Government College, Hoshiarpur herbario sub numero *Vasishta* 14.

Plant mass fibrous, yellowish brown to yellowish green ; trichomes straight or a little flexuous, 5.7-7.6 μ broad ; sheath thick, firm ; filaments 7.6-10.4 μ broad ; cells barrel-shaped or cylindrical, 4-11.5 μ long, contents granular ; false branches short ; heterocysts intercalary, 5.7-8.5 μ broad, 11.5-13.4 μ long, oblong or elliptical ; spores in series, 9.5-11.5 μ broad, 15.3-19.2 μ long, always alternating with dead cells, oblong or elliptical.

Habitat : In a stagnant water pond, Phagwara road, Hoshiarpur. Collected on September 12, 1959. Deposited in Government College, Hoshiarpur herbarium under reference number *Vasishta* 14.

The variety resembles the type in the shape of cells, heterocysts and spores ; the spores are formed in long series alternating with dead cells ; but differs in the smaller dimensions of the cells, heterocysts and spores.

This variety differs from the var. *tenuis* Rao (1937) in possessing (a) broader filaments and trichomes, (b) broader heterocysts, and (c) broader spores. The Hoshiarpur alga is intermediate between the type and variety *tenuis* Rao. It suggests the merger of the variety *tenuis* Rao with the type.

Family SCYTONEMATACEAE Rabenhorst

SCYTONEMA Agardh

38. **Scytonema hofmanni** Ag. [Synop. Algar. Suec. 117, 1817] ex Born. et Flah. Rev. Nostoc. Heterocyst. 97, 1887 ; Desikachary 476, pl. 91, fig. 2, 1959.

Lat. filament=11.3-13.4 μ ; lat. trichome=7.6-9.5 μ ; long. cell=7.6-15.3 μ ; lat. heterocyst=9.5-15.3 μ ; long. heterocyst=11.3-23 μ ; crass. vag.=1.7-2.7 μ.

Habitat : Forming cushion-like, broadly expanded thallus of blackish blue-green colour on moist sandy soil mixed with clay, Hoshiarpur.

39. **Scytonema ocellatum** Lyngbye [Hydroph. Danica 97, pl. 28 a, 1819] ex Born. et Flah. Rev. Nostoc. Heterocyst. 95, 1887 ; Desikachary 467, pl. 92, fig. 3, 1959.

Lat. filament=15.3-19.2 μ ; lat. trichome=9.5-11.5 μ ; long. cell=3.8-7.6 μ ; lat. heterocyst=11.5-13.4 μ ; long. heterocyst=11.5-15.3 μ ; crass. vag.=3.8-4 μ.

Habitat : On moist soil, Hoshiarpur.

40. **Scytonema millei** Bornet [in Bornet et Thuret, Not. Algol. 2 : 147, 1880] ex Born. et Flah. 93, 1887 ; Desikachary 460, pl. 93, fig. 2-3, 1959. (Plate II, Fig. 15)

Thallus woolly, expanded, light blue-green and yellowish brown ; filaments interwoven, 15.3-22 μ broad ; sheath thick, lamellated, firm, brownish, 3.4-5.1 μ thick ; trichomes constricted ; cells discoid in young and healthy trichomes, 11.5-14.3 μ broad, 4.7-9.5 μ long, becoming more or less quadrate in old trichomes, contents blue-green, granular ; heterocysts discoid, usually broader than the cells ; reproduction by hormogones ; false branches in pairs or even single.

Habitat : On moist soil near Model Town, Hoshiarpur. The type is being reported for the first time from the Indian soil.

Family MICROCHAETACEAE Lemm.

MICROCHAETE Thuret

41. **Microchaete tenera** Thuret var. **major** Moebius in Abh. Seuckenb. naturf. Ges. 343, pl. 2, figs. 2-4, 1894.

Lat. filament=11.5-13.4 μ ; lat. trichome=7.6-9.5 μ ; long. cell=8.5-11.5 μ ; diameter basal heterocyst=8.5-9.5 μ ; lat. intercalary heterocyst=7.6-9.5 μ ; long. intercalary heterocyst=11.5-19.2 μ.

Habitat : On submerged plant parts of *Trapa bispinosa*, Hoshiarpur. This variety is being reported from the Indian soil for the first time.

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Comments on Ripley's

A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN

BY

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(*With a Supplement by Sidney Dillon Ripley II*)

After Baker's FAUNA OF BRITISH INDIA, BIRDS (1922-1930), Ripley's A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN (1961) is the most important and standard reference work on Indian ornithology. In view of its importance, it is proposed to publish, from time to time, notes and comments on the contents of the book. It may be mentioned at the outset that I have no serious criticism of the volume, and the following notes are more in order to supplement the information already contained therein. Since the question of recognition of one subspecies or the other is largely a matter of opinion of individual zoologists, it is not proposed to discuss that aspect, except in very obvious cases.

Drs. Sálim Ali, K. K. Tiwari, Charles Vaurie, S. Dillon Ripley, and Ernst Mayr read a draft of this paper and offered helpful advice. I must, however, specially mention that Dr. Ripley has been kind enough also to point out to me some omissions and commissions in his book that escaped my notice ; and that Dr. Mayr, in spite of his extremely busy hours, has greatly helped me in the interpretation of certain articles of the new code of zoological nomenclature. To all of them I express my grateful thanks. I am also thankful to Mr. F. C. Sawyer, Librarian, Zoological Library, British Museum (Natural History), London, for his invaluable help in finding out the correct dates of publication of certain books and periodicals.

1. Map between pp. viii and ix. Despite the caption ' India and Pakistan before the 1956 re-organization of Indian States', it shows India as it was before the reorganization of Provinces in 1937, for no boundaries between India and Pakistan or Bihar and Orissa are given.

   Further, in place of ' N.W.F.D.' read ' N.W.F.P.'

2. p. 2, no. 4. As per no. 706 of the OFFICIAL LIST OF SPECIFIC NAMES IN ZOOLOGY, *Podiceps nigricollis* Brehm is the correct name for this species.

3. p. 12, no. 33. The name should be *Ardea insignis* Hume. Hume's name is available, since its citation as a synonym of *Ardea nobilis* Blyth and *Ardea sumatrana* Raffles are based on misidentification.

4. p. 13, no. 38. The name should be *Butorides striatus chloriceps* (Bonaparte), as has been shown by Biswas (1959, p. 288).

5. p. 21, no. 64. The name should be *Ciconia ciconia boyciana* Swinhoe, for Severtzov's *asiatica* is scarcely valid and is best synonymized with the nominate *ciconia* (see Baker, 1929, p. 321).

6. p. 49, no. 156. It also occurs in Nepal in winter (Scully, 1879, p. 225 ; Rand & Fleming, 1957, p. 54).

7. p. 52, no. 165. There is no recorded evidence of its breeding in Nepal.

8. p. 52, no. 166. The correct name is *Aquila chrysaetos daphanea* Severtzov, 1888, for it is not preoccupied by *A.* [*quila*] ? *Daphanea* Hodgson, 1844, which is a *nomen nudum* and hence has no nomenclatural standing. Ticehurst (1932) renamed this bird as *A. c. hodgsoni* because he thought that since Severtzov's name was cited in the synonymy it was not available. This was, however, unnecessary in reference to Art. 16 (b) (ii) of the New Code.

9. p. 72, no. 236. The type locality, Srinagar, as given by Hellmayr, is in Dehra Dun district, U.P., and not in Kashmir.

   Watson (1962) has recently shown that *Alectoris graeca* (Meisner) and *Alectoris chukar* (J. E. Gray) are distinct species.

10. p. 73, no. 238. Scully (1879, p. 348) reported it also from Nepal at *c.* 6000 ft.

11. p. 116, no. 383. The author of the name *Charadrius placidus* is J. E. Gray alone.

    The first (1846) edition of the CATALOGUE of Hodgson's collection was published under the joint authorship of J. E. and G. R. Gray (see announcement at the back of the second edition), although G. R. Gray alone was responsible for all new names proposed therein (see pp. iv-v of the first edition). The second (1863) edition was, however, all J. E. Gray's own work.

12. p. 122, genus *Capella* Frenzel. As per no. 58 of the OFFICIAL LIST OF GENERIC NAMES IN ZOOLOGY, *Gallinago* Brisson is the correct generic name for the snipes.

13. p. 156, no. 501. Robinson & Kloss's name was originally printed as *Treron bisincta praetermissa.*

    It occurs also in Nepal.

14. p. 162, no. 524. Blyth's name originally appeared as *C.* (*Alsocomus*) *puniceus.*

    It occurs also in south-eastern Bihar and southern West Bengal although rather scarce there.

15. p. 172, no. 562. Occurs below 2000 ft. also, for example, 800 ft. reported by Biswas (1961b, pp. 537-538).

16. p. 172, nos. 562 and 563. Husain (1959) has shown that *Psittacula himalayana* (Lesson) and *P. finschii* (Hume) are distinct species.

17. p. 173, no. 566. Hodgson obtained two specimens in Nepal (J. E. & G. R. Gray, 1846, p. 113).

18. p. 175, no. 572. Occurs also in Orissa (Mayurbhanj district, reported by Mukherjee, 1953, pp. 157, 160).

19. p. 205, no. 682. The subspecific name should be corrected to *monticola.*

20. p. 210, no. 700. The type locality of *Cypselus leuconyx* Blyth is Calcutta.

21. p. 217, no. 729. Occurs also in southern West Bengal.

22. p. 224, no. 755. In the reference mentioned, Stresemann refers only to the specimen(s) of *Coracias benghalensis* (L.) collected by P. Poivre, which did not form the basis of Linnaeus's description of the species.

    Regarding designation of a neotype for *Corvus benghalensis* Linnaeus, see Biswas (1961a), and for the Ruling (Opinion 663) given on the case by the International Commission on Zoological Nomenclature, see *Bull. zool. Nomencl.* **20**(3) : 195-196, April 1963.

23. p. 233, no. 783. Recorded also from Dehra Dun district, U.P. (Mukherjee, 1956, pp. 162-163 ; Rand & Fleming, 1957, p. 88).

24. p. 233, no. 784. Bonaparte's name was originally spelt as *Megalaima hodgsoni.*

25. p. 235, no. 792. Latham's name *Bucco indicus* occurs on page 205 of INDEX ORNITHOLOGICUS, vol. 1 (1), and its type locality is India.

26. p. 236, no. 793/794. No specimen of *Indicator xanthonotus* has yet been taken in Nepal. It is not known, therefore, if

the subspecies *radcliffi* or the nominate *xanthonotus* or both occur there.

27. p. 245, no. 827. The original name was published as *Picus* (*Chrysonotus* Swainson) *Grantia*, and its author is Horsfield.

28. p. 261, no. 877. The year of publication of Blyth's name is 1845, although it was due in 1844.

Under Range : delete ' western ' from Bihar.

29. p. 264, no. 888. It occurs in Nepal also (Sharpe, 1890, p. 585).

30. p. 271, no. 912. J. E. Gray's name *Hirundo chinensis* was published in 1830 in the ILLUSTRATIONS OF INDIAN ZOOLOGY, vol. 1, pt. 2, pl. 35, fig. 3.

31. p. 300, no. 1002. In the reference cited, Stresemann refers to *Sturnus Capensis* Linnaeus, 1766, and not to *Sturnus Contra* Linnaeus, 1758.

32. p. 305, no. 1020. The type locality of *Garrulus bispecularis* Vigors was earlier restricted to Murree by Baker (1922, p. 63).

33. p. 310, line 19. Delete ' Nepal ' from the range of the species *Dendrocitta frontalis* Horsfield.

34. p. 340, no. 1133. The type locality of *Trichophorus striatus* Blyth is Darjeeling.

35. p. 341, no. 1140. The type locality of *Trichophorus flaveolus* Gould was originally given as Himalaya Mountains, Nepal, etc. Baker's restriction to Cachar (Assam) cannot stand, for Cachar is neither in the Himalayas, nor in Nepal. It has, however, been restricted to Nepal by Koelz (1954, p. 10).

36. p. 343, no. 1146. Horsfield's name originally appeared as *Hypsipetes McClellandii*.

37. p. 366, no. 1228. The type locality of Tickell's *Motacilla rubricapilla* is not Manbhum, but 'Borabhum' (=Barahabhum, Purulia district, West Bengal).

38. p. 367, no. 1231. The year of publication of Gmelin's name *Parus sinensis* is 1789.

39. p. 370, no. 1241. Hodgson's specimen on which Sharpe named *Suthora humii* came from Darjeeling (Gray, 1863, p. 37). The restriction of the type locality to eastern Nepal is, therefore, unnecessary.

40. p. 382, no. 1279. Vigors's name was originally published as *Garrulus striatus*.

41. p. 383, no. 1280. Whistler died in 1943, and *vibex* was described in 1950. Naturally, he could not possibly write in his MS. notes anything about its occurrence in eastern Kumaon. However, he thus referred to the British Museum series from Nepal : ' These are called intermediate by B.M. but seem to me, particularly Scully's birds, close to typical race.'

42. p. 417, no. 1397. Lowndes (1955, p. 31) found it as far up as 10,500 ft. in Nepal.

43. p. 417, no. 1399. Koelz's restriction of the type locality of *Hypsipetes gracilis* Horsfield to Naga Hills may not be valid, for there is nothing to show that McClelland (the collector) ever visited that part of the country.

44. p. 433, no. 1447. Moore's name originally appeared as *Nemura Hodgsoni.*

45. p. 439, no. 1465. It occurs in Nepal also (J. E. & G. R. Gray, 1846, p. 93 ; Biswas, 1963a, p. 807).

46. p. 443, nos. 1477 & 1478. *Sylvia montana* Horsfield, 1821, is older than *Horornis fortipes* Hodgson, 1845. The names of nos. 1477 and 1478 should, therefore, be changed to *Cettia montana pallidus* (Brooks) and *Cettia montana fortipes* (Hodgson), respectively.

47. p. 457, no. 1528. *Prinia catharia* Reichenow, 1908, is an older name for this bird.

48. p. 459, no. 1534. The type locality of *Graminicola bengalensis* Jerdon is Cachar. Although Jerdon (1863, p. 177) mentioned 'Ganges' first, he (loc. cit., note) clearly stated that he did not procure any specimen there, and that his first specimens were taken in Cachar. The type locality being the place of origin of the first specimen (type), only Cachar can qualify.

49. p. 471, no. 1570. Biddulph (1881, p. 67) obtained a specimen of *Sylvia alathaea* in Gilgit in May, and Scully (1881, p. 450) recorded it breeding there.

50. p. 478, no. 1592. The type locality of *Regulus inornatus* Blyth is Darjeeling.

Proud (1955, p. 63) reported it also from Nepal.

51. p. 487, no. 1620. *Seicercus poliogenys* (Blyth) has also been known from Nepal (Gray, 1863, p. 32 ; Proud, 1955, p. 65).

52. p. 488, no. 1622. According to Art. 58 (8) of the International Code of Zoological Nomenclature (1961), *Abrornis albigularis* Blyth, 1861, is preoccupied by *Abrornis albogularis* Moore,

1854. The next name available, *Abrornis flaviventris* Jerdon, 1863, should, therefore, be used for this form.

It has also been known from Nepal (Gray, 1863, p. 33 ; Biswas, 1962b, p. 423).

53. pp. 496-497, no. 1647/1648. Summer birds from Manangbhot, northern central Nepal, taken between 13,000 and 15,000 ft. by Lowndes (1955, p. 32) have been identified as nominate *pectoralis*.

54. p. 503, no. 1671. The description of *Ruticilla phoenicuroides* Moore occurs in vol. 1 of Horsfield & Moore's work.

55. p. 506, no. 1678. Moore's name originally appeared as *Ruticilla Vigorsi*.

56. p. 507, no. 1680. It occurs much below 6000 ft., for example, Stevens's (1925, p. 358) report from Bhutan Duars (500 ft., O'Donel coll.) and from Nurbong (2000 ft.); Biswas's (1962a, p. 662) record from central Nepal at *c*. 1000 ft.

57. p. 514, no. 1700. The author's name Sykes should not be enclosed in parentheses.

58. p. 543, no. 1785. The subspecific name was originally published as *sushkini*.

59. p. 557, no. 1823. Also reported as far west as the Gandak-Kosi watershed, central Nepal (Proud, 1952, p. 362).

60. p. 571, no. 1865. The author of the name *Anthus pelopus* is G. R. Gray (see remark on no. 383).

61. p. 576, no. 1883. Hodgson's name was originally published as *Motacilla* (*Budytes*) *Calcarata*.

62. p. 583, no. 1906. The date of publication of Baker's name *Chalcoparia singalensis rubinigentis* in his FAUNA OF BRITISH INDIA, BIRDS vol. 7, as given, that is, 14 May 1930, does not seem to be correct. This date has presumably been obtained from the set of Baker's work in the Zoological Library of the British Museum. Inserted in the vol. 1 of that set is a handwritten memorandum from the publishers addressed to the late Sir Norman Kinnear, giving the actual dates of publication of the various volumes. In it the date for vol. 7 is written as 14 May 1930 which is obviously a slip of the pen (probably intended to be 14 March 1930), for the copy of vol. 7 of the same set is datestamped 23 April 1930 by the Library ! Again, the publishers have recently informed me that the date on the title pages of the volumes are the dates on which they

were published and were available for sale to the public, which, for vol. 7, is March 1930. Baker's name should, therefore, have priority over Kloss's, and the Indian Rubycheek should be known as *Anthreptes singalensis rubinigentis* (Baker).

63. p. 611, no. 1989. Reported also from Nepal (Lowndes, 1955, p. 34, from Manangbhot, northern central Nepal, at *c.* 10,000-13,000 ft., in summer).

64. p. 616, no. 2004. Recorded also from eastern Nepal (Biswas, 1963b, p. 194).

65. p. 634, no. 2055. Sharpe's name was published in 1888.

It has also been known from Nepal (Gray, 1863, p. 57).

66. Various pages. Add Andaman Islands in the ranges of :

nos. 14 (p. 5), 17 (p. 7), 44 (p. 15), 49 (p. 16), 114 (p. 37), 133 (p. 43), 147 (p. 47), 175 (p. 55), 191 (p. 60), 193 (p. 60), 222/223 (p. 68), 337 (p. 101), 346 (p. 103), 371 (p. 112), 379 (p. 115), 409 (p. 124), 418 (p. 128), 424/425 (pp. 129-130).

Add Nicobar Islands in the ranges of :

nos. 18 (p. 7)—definite records ; 49 (p. 16)—probable records ; 52 (p. 17)—definite record ; 418 (p. 128)—doubtful record.

Add Andaman and Nicobar Islands in the ranges of :

nos. 21 (p. 8), 37 (p. 13), 48 (p. 16), 57 (p. 18), 373 (p. 113), 374 (p. 114), 385/386 (p. 117), 387/388 (p. 117), 393/394 (p. 119), 396 (p. 120), 406 (p. 123), 422 (p. 129), 434 (p. 133).

(See Ball, 1873 ; Hume, 1873, 1874, 1876 ; Butler, 1899-1900 ; Kloss, 1903 ; Osmaston, 1906).

67. Various pages. The author of the following names is Horsfield :

Hirundo brevirostris (p. 205, no. 683) ; *Coracias affinis* (p. 225, no. 757) ; *Phaenicornis elegans* (p. 325, no. 1080) ; *Hypsipetes gracilis* (p. 417, no. 1399).

The author of *Spizaetus rufitinctus* (p. 46, no. 144) and *Ianthocincla gularis* (p. 385, no. 1288) is McClelland.

The date of publication of all the abovementioned names and of *Mirafra Assamica* Horsfield (p. 260, no. 873), *Hirundo brevicaudata* Horsfield (p. 271, no. 912), *Dendrocitta frontalis* Horsfield (p. 310, no. 1035), *Muscicapa* ? *capitalis* Horsfield (p. 320, no. 1064), *Phaenicornis affinis* McClelland (p. 326, no. 1084), *Saxicola* ? *olivea* McClelland (p. 441, no. 1472), and *Cinnyris labecula* Horsfield (p. 590, no. 1928) is best given as 1839 (1840).

68. Various pages. The author of the following names is Moore (*in* Horsfield & Moore) :

Delichon nipalensis (p. 277, no. 932), *Pnoepyga longicaudatus* (p. 358, no. 1202), *Accentor rubeculoides* (p. 542, no. 1781).

69. Various pages. The authorship of J. E. Gray's ILLUSTRATIONS OF INDIAN ZOOLOGY (London, 1830-1835) has been given to Hardwicke as well as to Gray & Hardwicke. A perusal of the title page of the work leaves one without doubt that the author is J. E. Gray alone.

Kinnear (1925) and Sawyer (1953) have written on the dates of publication of the various plates.

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SUPPLEMENT

Additions and corrections to A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN, and a comment. By Sidney Dillon Ripley II.

p. 5. Add species 13a :

Bulweria fallax Jouanin

Small Black Petrel

Northern Indian Ocean.

13a. **Bulweria fallax** Jouanin

Bulweria fallax Jouanin, 1955, *L'Oiseau* **25** : 156. (Near Socotra, 12° 30′ N., 55°E.)

Range.—Northern Indian Ocean (see Jouanin, 1957, L'Oiseau **27** : 12-27), wandering perhaps as far east as the western coast of India. The record of the Mascarene Black Petrel, *Bulweria aterrima*, should be treated as unresolved until fresh specimens come to hand to determine to which species birds near the coast might be assigned.

p. 14. no. 42. This should be read as :

Ardeola grayii grayii (Sykes)

and 'Maldive' deleted from its Range.

p. 14. Add race 42a :

42a. **Ardeola grayii phillipsi** Scheer

Ardeola grayii phillipsi Scheer, 1960, *Senck. biol. Frankfurt am Main* **41** : 145. (Hitadu, Addu-Atoll, Maldives.)

Range.—Southern Maldive Islands, Addu and Suadiva.

p. 122. Genus **Capella** Frenzel :

The International Commission of Zoological Nomenclature (1957) have decreed that the snipe species at present included in the genus *Capella* should be transferred to '*Gallinago* Brisson 1760', and this is what Dr. Biswas is referring to in his comments on my treatment of these species in the SYNOPSIS. However, Dr. Alexander Wetmore, (1958, *Ibis* **100** : 125-127) has shown that the Commission has attempted to validate as a genus a term that does not have generic status. Thus current standard lists such as the American Ornithologists' Union CHECK LIST (1957) and the South African CHECK LIST (1952) as emended by the Seventh Report (1963, *Ostrich* **34** : 40) as well as my SYNOPSIS continue to recommend the use of the genus *Capella* pending further study.

p. 205. Add species 683a :

Collocalia maxima Hume

Low's Swiftlet

Bhutan, southeast Tibet, east to Thailand, Viet Nam, Malaya, Sumatra, Java and Borneo.

683a. **Collocalia maxima maxima** Hume

Collocalia maxima Hume, 1878, *Stray Feathers* **6 :** 49. (Tenasserim.)

Range.—Eastern Bhutan and southeast Tibet (skins in B.M.) from 7000 to 12,750 feet, *vide* Medway, 1961, J.B.N.H.S. **59** : 149.

p. 206, no. 685. This should be listed as a species :

Collocalia unicolor (Jerdon)
Indian Edible-nest Swiftlet

Southern India and Ceylon.

685. **Collocalia unicolor** (Jerdon)

Hirundo unicolor Jerdon, 1840, *Madras Jour. Lit. Sci.* **11** : 238. (Coonoor.)

Range.—as stated.

p. 206, the citation **Collocalia inexpectata** ume, Hand no. 686 following it should be read as :

Collocalia fuciphaga (Thunberg)
Greyrumped or White-nest Swiftlet

Andaman and Nicobar islands east into the coastal Indochinese and Malaysian subregions, Philippines and Lesser Sunda Islands.

686. **Collocalia fuciphaga inexpectata** Hume

Collocalia inexpectata Hume, 1873, *Stray Feathers* **1** : 296, in text. (Andaman Islands.)

Range.—as seated.

p. 325. Add race 1080a :

1080a. **Pericrocotus flammeus andamanensis** Beavan

Pericrocotus andamanensis 'Tytler'=Beavan, 1867, *Ibis*: 322. (Andaman Islands.)

Range.—Andaman Islands.

p. 599, no. 1954. Additional note to range, **Montifringilla ruficollis :**

Sight record, Bass (1963, pers. comm.), Jalapahar, Darjeeling *c.* 7500 ft., Oct. 12, 1956.

Field Guide to the Amphibians of Western India

PART 2

BY

J. C. DANIEL
Curator, Bombay Natural History Society

(*With two plates and four text-figures*)

[*Continued from Vol.* **60** (2) : 438]

Family MICROHYLIDAE: Narrow-mouthed Frogs

These frogs are easily distinguished by the smallness of the head in relation to the body. They are not uncommon but, being fossorial forms, are rarely seen except during the breeding season. Many species live more or less exclusively on ants and termites and are often seen in association with termite colonies. The family is widely distributed and occurs in the tropics of both hemispheres.

The narrow-mouthed frogs differ from the frogs (Ranidae) and tree frogs (Rhacophoridae) by the absence of teeth in the upper jaw and the entire nature of the tongue, and are distinguished from the toads (Bufonidae) by the circular or oval tongue, the circular or vertical pupil, and the smooth skin of the body. Within the family, two characters are of importance in separating the genera, the presence or absence of ridges on the palate in front of the pharynx and the presence or absence of disc-like dilatations on the finger tips. In all Indian microhylids, the tympanum is hidden or absent and the first finger is shorter than the second. The tadpoles lack teeth rows on the lips. Five genera with nine species occur in India.

KEY TO THE GENERA OF MICROHYLIDAE

1.	Tips of fingers not dilated	.. 2
	Tips of fingers dilated into discs	.. 4
2.	Palate without ridges	.. *Melanobatrachus*
	Palate with ridges	.. 3

3. No papillae behind internal nares. Size small, when adult less than 35 mm. from snout to vent .. *Microhyla*
   Papillae present below internal nares. Size large, when adult over 40 mm. from snout to vent .. *Uperodon*
4. A bony ridge immediately below internal nares .. *Kaloula*
   A fleshy ridge some way below internal nares .. *Ramanella*

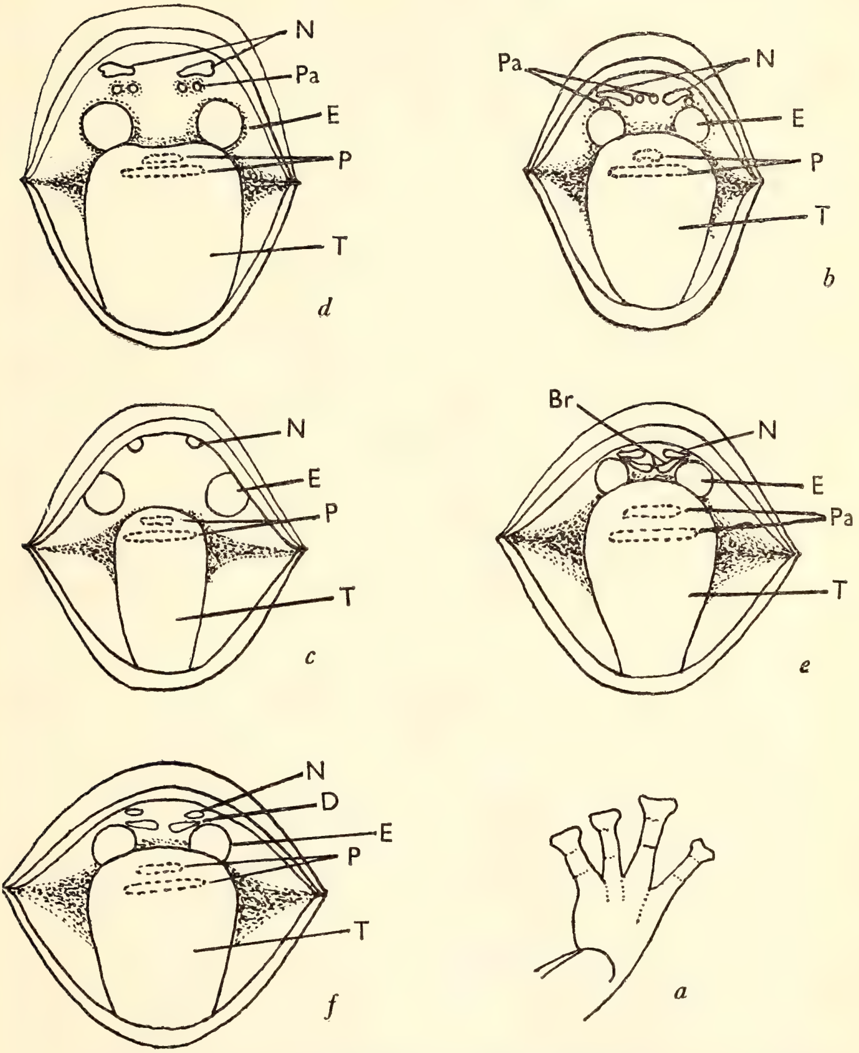

Fig. 15. *a.* Hand of *Ramanella montana*; Mouth of : *b. Uperodon systoma* ; *c. Microhyla ornata* ; *d. Uperodon globulosum* ; *e. Kaloula pulchra taprobanica* ; *f. Ramanella montana.*

N : internal nares ; Pa : papilla ; E : inner bulge of eye ; P : dotted lines on tongue indicating position of palatal ridges ; T : tongue ; Br. Bony ridge ; D. dermal ridge

Genus **Melanobatrachus** Beddome 1878

Restricted to south-west India. One species.

Melanobatrachus indicus Beddome 1878 : Black Microhylid

Diagnosis[1]. Distinguished from other species of the family by the absence of palatal ridges. Size small, 34 mm. in snout-to-vent length. Interorbital width broader than upper eyelid; pupil circular; tongue oval entire; toes webbed at base; sub-articular tubercles and inner metatarsal tubercle indistinct; tibio-tarsal articulation reaches to midway between shoulder and eye. Skin pustular above, smooth below.

Colour. Black. Thigh with a continuous or interrupted quarter-inch-broad scarlet band near groin. A few scarlet blotches on chest, between forelegs, and on lower portions of hindlegs sometimes present.

Distribution. A rare species. Collected only from the Anamalais and other hill ranges in Kerala.

Habits. Beddome (1878) remarks that he collected the frogs in moist evergreen forest at an elevation of 4000 ft. (*c.* 1219 m.), torpidly curled up almost into a ball under old rotten logs.

Breeding habits and larvae unknown.

Genus **Microhyla** Tschudi 1838

The genus is widely distributed in south-east Asia and from Brazil to the southern United States of America. Two species occur in India.

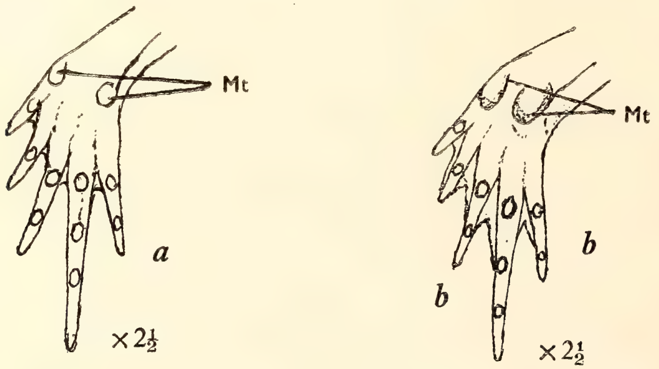

Fig. 16. Hindfoot of : *a. Microhyla ornata* ; *b. Microhyla rubra* (both ventral views)

Mt : metatarsal tubercle

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[1] Based on Beddome, Lt.-Col. R. H. (1878) : Description of a new Batrachian from South India belonging to the family Phryniscidae. *Proc. Zool. Soc. London* : 722-3.

KEY TO THE SPECIES OF *MICROHYLA* TSCHUDI 1838

Habit slender, two normal metatarsal tubercles ..	*ornata*
Habit stout, two shovel-shaped metatarsal tubercles ..	*rubra*

Microhyla ornata (Dum. & Bibr.) 1841 : Ornate Microhylid

(Text-fig. 15*c*, 16*a*, 17)

Diagnosis. A small slender microhylid rarely exceeding 25 mm. in snout-to-vent length. The colour pattern of the back is distinctive. Interorbital width nearly twice as broad as upper eyelid. Toes with a rudiment of web. Two prominent metatarsal tubercles. Tibio-tarsal articulation reaches to the shoulder or to slightly beyond the anterior border of eye. The heels meet when the legs are held at right angles to the body. Skin smooth or slightly tubercular.

Colour. The characteristic pattern on the back, which may be bright pink or brown of varying shades, begins between the eyes where it extends to both eyelids, narrows on the nape, widens above the shoulder, narrows again, and finally broadens out sending a stripe to the groin and the thigh. A dark streak from behind the eye to the shoulder, limbs crossbarred. White below, throat and chest may be stippled with brown. Throat in breeding male black.

Distribution. India, Ceylon, south-east Asia, south China, and Formosa.

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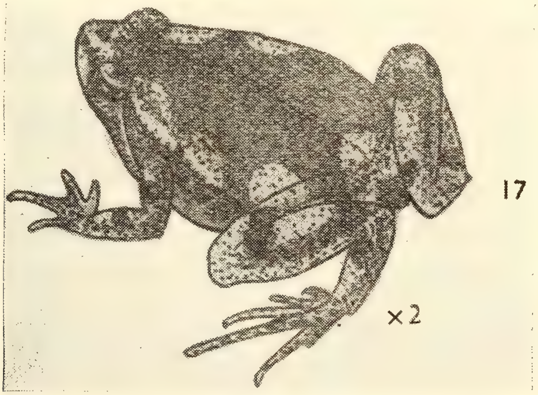

Fig. 17. *Microhyla ornata* × 2

Breeding. The breeding season commences once the monsoon rains have well set in and occurs throughout the monsoon period in south-western India. The period varies with the rainy season in different areas of its distributional range. Flower (1899)[1] records tadpoles between December and February in Malaya. The male can be heard calling at night near temporary rainwater pools and similar situations. Several males may call from the same area but, though the call is startlingly loud for an animal of its size, it is ventriloquistic and makes location of the small frog sitting in the midst of grass or among stones extremely difficult. In this, as in some other species of *Microhyla*, I believe the male remains stationary and is located by the female by its call. McCann (1940)[2] records the number of eggs in a female collected in September as approximately 200. Earlier (1932)[3] he opines that eggs are laid singly in separate mucilaginous envelopes. However, Ferguson (1904)[4] states that the eggs which measure 2 mm. in diameter are laid in flat transparent masses. I have, unfortunately, no personal record. The tadpoles are transparent and have a diamond-shaped mark of almost gold colour on the head. The head and body are massive and the tail which is half as long as the head and body ends in a short terminal flagellum. They move in shoals just below the surface of the water or at the surface. According to C. R. Narayan Rao (1917)[5] the large air spaces which occur in the gill chambers provide the necessary buoyancy and the offensive secretion of two cephalic glands makes them unpalatable to fishes and other aquatic life thus offering them protection in spite of the exposed nature of their movements. The tadpoles are microphagus. Parker (1928)[6] suggests that the flagellated tail helps the tadpole to maintain a stationary position while feeding by counteracting the forward thrust of the water taken in through the mouth and filtered out by the gills through the spiraculum. When feeding the tail is bent back almost parallel to the body and the flagellum at the tail tip vibrated rapidly. Unlike in the adult the toes when they appear are completely webbed. Development is rapid and the young measure *c.* 9 mm. at metamorphosis.

Habits. This pretty little microhylid is the commonest species of the family and one of the smallest of Indian amphibians. It has adapted itself to life in different biotopes, and occurs in desert areas like Cutch and areas of heavy rainfall as Kerala and Assam. It is found in the plains and to about 5000 ft. (1524 m.) in the hills. While it aestivates when conditions are unsuitable, it may be found throughout the year in suitable areas with cover and moisture. The juvenile frogs may be seen for a short period in the dried-up but still moist beds of temporary rainwater pools well after the monsoon season. The dispersal of young which occurs among toads from the breeding area apparently does not happen to a similar extent in this species. Unlike many microhylids this frog is quite agile and difficult to capture. It feeds mainly on ants and other small-sized insects.

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[1] Flower, S. S. (1899) : Notes on a second collection of Batrachians made in the Malay Peninsula and Siam, from November 1896 to September 1898, with a list of species recorded from those countries. *Proc. Zool. Soc. London* : 885-966.

[2] McCann, C. (1940) : A Reptile and Amphibian Miscellany. *J. Bombay nat. Hist. Soc.* **42** (1) : 45-64.

[3] ——— (1932) : Notes on Indian Batrachians. ibid. **36** (1) : 152-180.

[4] Ferguson, H. S. (1904) : A list of Travancore Batrachians. ibid. **15** (3) : 499-509.

[5] Rao, C. R. N. (1917) : On the occurrence of iridocytes in the larva of *Microhyla ornata* Boul. *Rec. Indian Mus.* **13** : 281-92.

[6] Parker, H. W. (1928) : The Brevicipitid frogs of the genus *Microhyla*. *Ann. Mag. Nat. Hist.* **2**, 10th series, 473-99.

Microhyla rubra (Jerdon) 1854: Red Microhylid

(Text-fig. 16*b*, 18)

Diagnosis. A stout small frog distinguished from *Microhyla ornata* by its well-developed shovel-shaped metatarsal tubercles and more webbed toes, the web reaching the last row of tubercles in the male and midway between the first and second row of tubercles in the female. Sub-articular tubercles prominent. Tibio-tarsal articulation reaches to between the shoulder and the eye. Skin smooth or slightly warty above; a fold from eye to shoulder. Smooth below except anal region which is granular. Heels may or may not meet when the legs are held at right angles to the body.

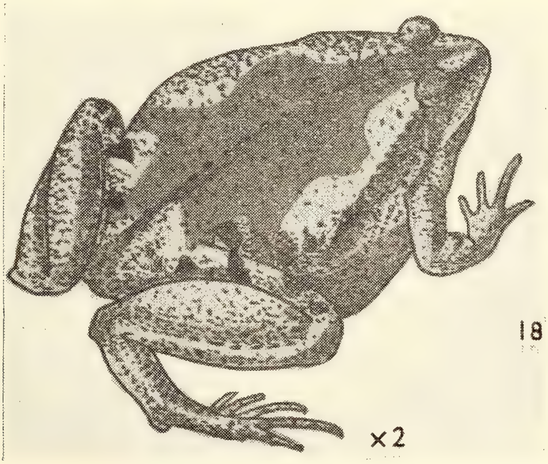

Fig. 18. *Microhyla rubra* × 2

Colour. Head and back red bounded by two dark bands along flanks from tip of snout to groin. Back with or without traces of dark pattern, usually broken-up. Limbs indistinctly crossbarred; white below, throat and chest light brown. Male with subgular vocal sac which area is black in the breeding season.

Distribution. South India, Ceylon, Assam. Not recorded north of Malabar in western India and Bangalore in the Peninsula. This species is likely to be more widespread than the collection records indicate.

Breeding. The breeding season coincides with the monsoon and in areas which receive both the south-west and the north-east monsoons tadpoles may be seen from June to November. The eggs are laid in flat transparent masses as in *M. ornata* but are of large size, 5 mm. in diameter (Ferguson op. cit.). Tadpoles similar to those of *M. ornata* but have a longer tail, over twice the length of head and body. Transparent with reddish pink tint according to Ferguson (op. cit.) but noted as olive above beautifully marbled by C. R. N. Rao (1915)[1]. Parker (op. cit.) suggests that the difference in colour may be due to local variation. The spawn is laid in rainwater pools. Tadpoles similar in habit to *M. ornata* tadpoles. Development is rapid.

Habits. A fossorial species unlikely to be seen except during the breeding season. The specimens collected by me were from sandy river beds and according to Ferguson (op. cit.) the species is fairly common in the low country of Kerala. C. R. N. Rao (op. cit.) states that the call is akin to the chirping of crickets but can be distinguished from a cricket's as it is interrupted and not continuous.

Genus **Uperodon** Dum. & Bibr. 1841 : Balloon Frogs

The rotund shape of the species of this genus makes them distinctive. The mouth has a short ridge ending in one or two papillae behind or between the internal nares. The genus is restricted to India. Two species are known.

KEY TO SPECIES OF THE GENUS *UPERODON*

A pair of 'papillae' together below internal nares. Interorbital width nearly thrice upper eyelid. Colour uniform brown or grey (Text-fig. 15*d*). ..	*globulosum*
A pair of 'papillae' between the internal nares and a papilla below each internal nare. Interorbital width about twice upper eyelid. Back marbled (Text-fig. 15*b*) ..	*systoma*

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[1] Rao, C. R. N. (1915): Some south Indian Batrachia. *Rec. Indian Mus.* **11** : 31-8.

Uperodon globulosum (Günther) 1864 : Balloon Frog

(Plate III, Text-fig. 15*d*)

Diagnosis. Head small with rounded snout and beady eyes; interorbital width 2½ to 3 times the breadth of the upper eyelid. Hindlegs short with two large shovel-shaped metatarsal tubercles. Toes with a rudiment of web, tibio-tarsal articulation does not reach the shoulder.

Skin smooth above and smooth or wrinkled below. Anal region granular. An occipital fold and an indistinct fold from eye to shoulder, uniform brown or grey above, white below with tinges of yellow during the breeding season. Throat black in the breeding male.

Distribution. Bengal (Calcutta, Jalpaiguri), Orissa (Russelkonda), Madhya Pradesh (Berar), Gujarat (Surat Dangs)[1], Maharashtra (Bombay), Mysore (Khanapur).

Breeding. The breeding season coincides with the onset of the monsoon in western India. This species was first recorded breeding in cisterns in rock near Kanheri caves, Salsette Island, Bombay; however, later observations have shown that the species breeds in any standing water, even temporary rainwater pools which may dry up in a few days. The call is a loud grunting *oink* and helps the female to locate the male. Tadpoles are active swimmers. In colour they are olive-brown above with a whitish tail which is striped longitudinally with dark blotchy lines. Flanks and below spotted with dark. The tadpoles are microphagus.

Habits. This species was considered to be rare but recently Abdulali (1962)[2] found them at Khanapur, in Mysore, in large numbers in the month of May. The species has, perhaps, a wider distribution than what the collection records indicate, but as a completely fossorial species it is not seen above ground except during the breeding season. Apart from collections made at breeding spots the species has been seen mainly in termite nests, and it would appear that this sedentary species restricts its movements to finding and burrowing into the nests of their main food, termites and, perhaps, ground-dwelling ants. They are excellent burrowers and in loose soil using their powerful metatarsal tubercles quickly burrow and disappear underground. While burrowing the soil is dislodged by sideways movements of the legs and the animal literally subsides into the ground; the eyes disappear last, leaving no trace above of its presence inside. In clayey soil, however, an opening to the outside may be seen. Dampness of the soil is essential for their well-being and they live at considerable depths in the dry months—one specimen has been collected at a depth of eight feet and lived for about 13 months without food, showing no effects of starvation during the first nine months (D. D. Mukerji, 1931)[1]. The globular shape is partly due to the enormously distensible lungs which when inflated rise above the level of the backbone. The skin exudes a sticky secretion when the animal is kept above the soil. On land they move with short hops or slow walk. In water they float and are at the most feeble swimmers.

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[1] *infra* page 742.

[2] Abdulali, Humayun (1962): An account of a trip to the Barapede Cave, Talewadi, Belgaum District, Mysore State, with some notes on Reptiles and Amphibians. *J. Bombay nat. Hist. Soc.* **59** (1): 228-37.

Uperodon systoma (Schneider) 1799 : Marbled Balloon Frog

(Plate III, Text-fig. 15*b*)

Diagnosis. Distinguished from *U. globulosum* by its coloration, its smaller size, and the interorbital width being narrower—1¾ to twice the width of the upper eyelid, and the papillae in the mouth consisting of a pair between the internal nares and one below each nare.

Colour. Olive to fawn or pinkish above, marbled or spotted with dark brown. Below white, throat often mottled with brown. Breeding male has the vocal sac area black and lower lip tinged with yellow.

Distribution. Agra, Allahabad in the Gangetic plain, south India (common at Madras). In western India only recorded in south Kerala. The species may prove to be more widespread than recorded.

Breeding. Ferguson (op. cit.) recorded it as breeding in Trivandrum in June and July. Like other species of Indian Amphibia breeding coincides with the rainy season and would vary with the advent of the rainy season in different areas of its distribution. The call has been compared to the bleating of a goat (C. R. N. Rao, 1918)[2]. The vocal sac distends enormously and looks more like a float than a resonator while the animal is calling from water. The eggs are laid in masses. The tadpole is indistinguishable from that of *U. globulosum*.

Habits. Similar to *U. globulosum.*

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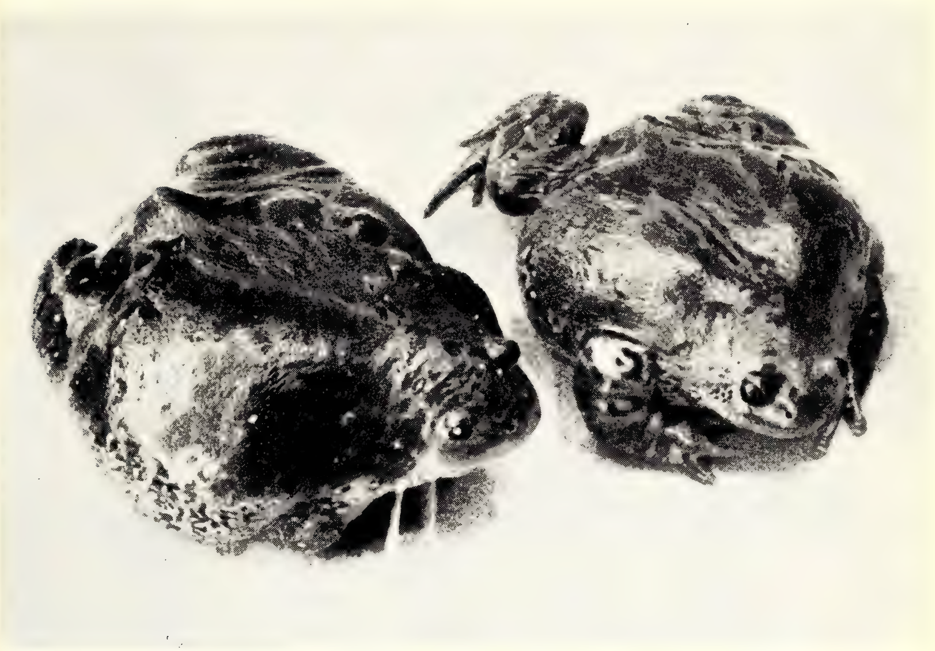
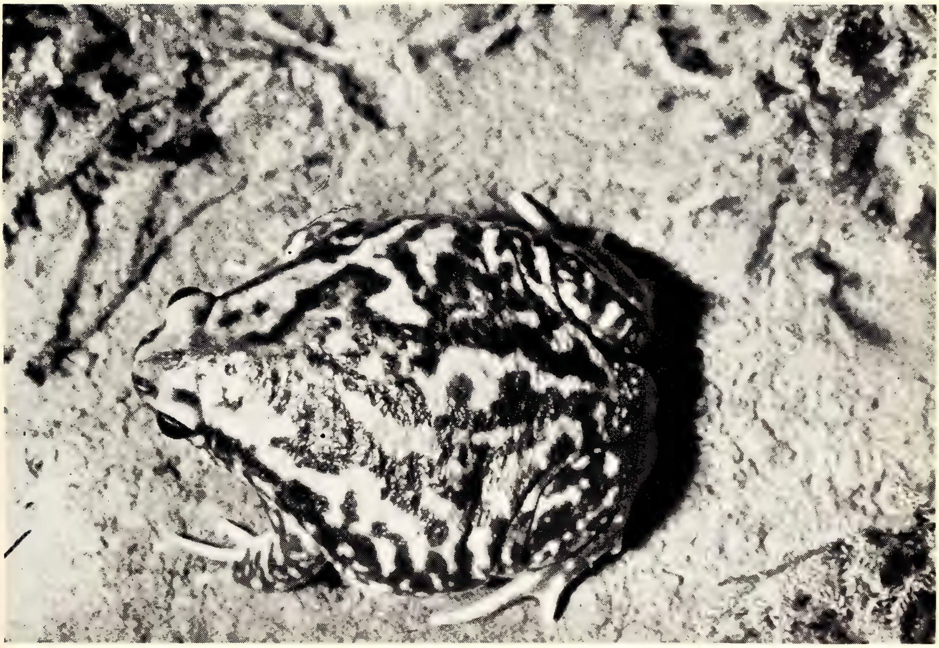
[1] Mukerji, D. D. (1931) : Some observations on the burrowing toad *Cacopus globulosum* Günth. *J. Proc. Asiatic Soc. Bengal*, N.S., **27** : 97-100.

[2] Rao, C. R. N. (1918) : Notes on the tadpoles of Indian Engystomatidae. *Rec. Indian Mus.* **15** : 41-5.



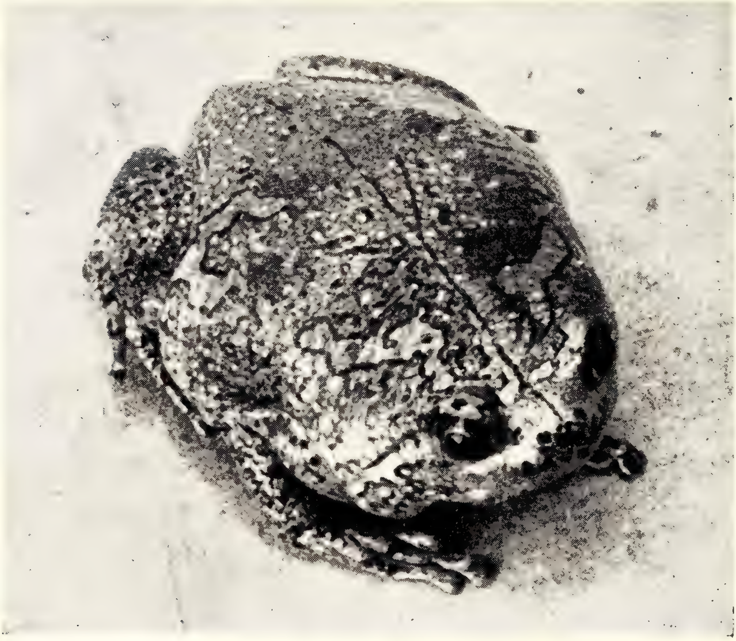
Balloon Frog, *Uperodon globulosum*

(*Photo : J. C. Daniel*)



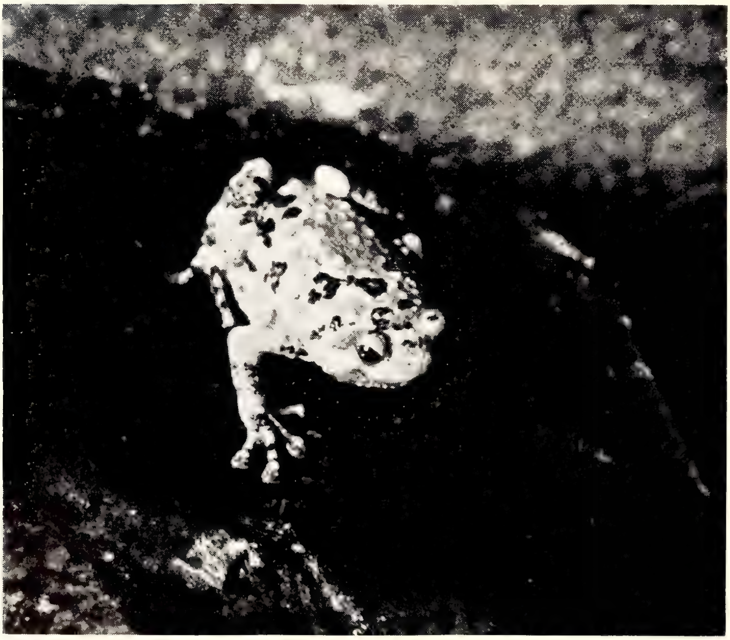
Marbled Balloon Frog, *Uperodon systoma*

(*Photo : S. R. Sane*)



Ceylon Kaloula, *Kaloula pulchra taprobanica*

(*Photo : J. C. Daniel*)



Jerdon's Ramanella, *Ramanella montana*

(*Photo : S. R. Sane*)

Genus **Kaloula** Gray 1831

(Text-fig. 15*e*)

Diagnosis. A strong bony ridge behind opening of internal nares; tip of fingers dilated into discs, toes webbed. A single species in India.

Kaloula pulchra taprobanica Parker 1934 : Ceylon Kaloula

(Plate IV, Text-fig. 15*e*)

Diagnosis. A medium-sized stout microhylid immediately distinguished from all other Indian frogs and toads except *Ramanella* by having only the finger tips dilated into discs. Distinguished from *Ramanella* by the presence of bony ridges immediately below choanae.

Head short, rounded, with indistinct canthus rostralis; interorbital space broader than upper eyelid; fingers with well-developed truncate discs which are twice as wide as the last phalange; toes about $\frac{1}{3}$-webbed; two strong compressed metatarsal tubercles; tibio-tarsal articulation reaches to the shoulder.

Colour pattern is distinctive and consists of blackish brown and bright red areas. A wide median blackish brown area bordered by two dorso-lateral bands of red and narrow interorbital band of red. In addition there are spots and patches of red within the black pattern. Light grey below, spotted or marbled with brown. Chin and throat black in breeding male.

Distribution. South India (Cauvery River), Calcutta, Ceylon; in western India collected at Khanapur, North Kanara.

Habits. Very little information is available on the habits of this microhylid. Breeding habits unknown but they have been observed in copula in temporary rainwater pools in May at Dandeli by Abdulali (op. cit.), who records the call as shriller than that of the smaller *Ramanella montana*. The nominate race *Kaloula pulchra pulchra* Gray is widely distributed in south-east Asia.

Genus **Ramanella** C. R. N. Rao & B. S. Ramanna 1925

The genus is found only in peninsular India and Ceylon. Three species occur in India.

KEY TO THE SPECIES OF THE GENUS *RAMANELLA*

1.	**Belly immaculate white ..**	*variegata*
	Belly brown or black spotted or marbled with white ..	2
2.	**Toes free ..**	*triangularis*
	Toes webbed ..	*montana*

Ramanella variegata (Stoliczka) 1872 : Variable Ramanella

(Text-fig. 19)

Diagnosis. A small microhylid, less than 40 mm. in snout-to-vent length. Post-narial ridges sometimes pigmented; finger discs triangular nearly twice the width of penultimate joint; toes with rudimentary web; two metatarsal tubercles; tibio-tarsal articulation reaches shoulder. Skin smooth.

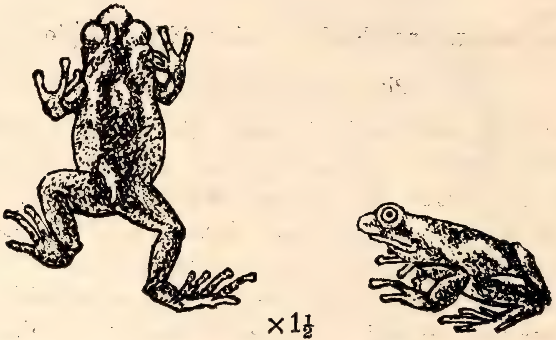


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Fig. 19. *Ramanella variegata* nat. size.
(After Günther 1875)

Colour. Brown with lighter marblings or spots, no stable pattern. White below, chin and throat may be brown stippled.

Distribution. Mainly recorded from eastern peninsular India, up to Chanda in Madhya Pradesh.

Breeding. Very little information is available on the breeding habits. C. R. Narayan Rao (1918, op. cit.) syllabilises the call as *ghauy, ghauy* usually heard after heavy rainfall. The tadpoles are brown or grey with minute black spots and occasionally a blue spot on each side of the body. They are bottom dwellers and development is rapid being completed within a month.

Habits. On its habits Narayan Rao & Ramanna (1925)[1] state that it is most often found in termitaries or under stones in association with large black scorpions *Heterometrus* sp. When disturbed they briskly crawled over the scorpions but when the scorpions went over them in turn flattened out and froze. In soft soil they burrow well but usually remain with the nose above ground probably related to their habit of living under stones which makes deep burrows unnecessary. They can climb well. The specimens housed in the Society were collected by Humayun Abdulali while they were climbing on the walls of a well at Chanda.

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[1] Rao, C. R. N. & Ramanna, B. S. (1925) : On a new genus of the Family Engystomatidae (Batrachia). *Proc. Zool. Soc. London* : 587-97.

Ramanella triangularis (Günther) 1875 : Triangle-Spotted Ramanella

Diagnosis. Size small, 40 mm. in snout-to-vent length; post-narial ridges strong, narrowly separated from each other; finger discs less than twice width of penultimate joint; toes free; two metatarsal tubercles; tibio-tarsal articulation reaches shoulder or between shoulder and eye. Skin smooth.

Colour. Pattern distinctive consisting of a lateral streak, a dorsal patch breaking into two stripes at the loins at right angles to the length of the animal, and a triangular patch enclosing the anus. Fore- and hind-limbs banded. Ventrally spotted with white on a brown ground colour.

Distribution. Malabar (Kerala) and Nilgiri Hills (Madras).

Breeding. The tadpoles are transparent but become brown when the front limbs emerge. Metamorphosis completed within a month (C. R. N. Rao, 1918, op. cit.).

Habits. Little known. Have been collected under logs and stones in forest.

Ramanella montana (Jerdon) 1854 : Jerdon's Ramanella

(Plate IV, Text-fig. 15*a*, 15*f*)

Diagnosis. Size small, about 35 mm. in snout-to-vent length. Post-narial ridges well marked and nearly in contact on mid-line; finger discs twice as broad as penultimate joint. Toes webbed, webbing more extensive in the male than the female; two metatarsal tubercles; tibio-tarsal articulation reaches to shoulder or between shoulder and eye. Skin smooth.

Colour. Brown of varying shades, uniform or with darker spots, the pattern varies. Below dark brown, almost blackish, with white spots or blotches.

Distribution. South-west India from the Dangs (*infra* p. 742) to south Kerala.

Breeding. Coincides with the monsoon. The call is recorded by Abdulali (1962, op. cit.) as deeper in tone than that of the larger *Kaloula p. taprobanica.* The tadpoles have been described by Ferguson (1904, op. cit.) as greenish brown, mottled darker above

Tail pinkish spotted with brown. Length of larval period and breeding habits not recorded.

Habits. This species is not uncommon in the Bombay area and was first reported by McCann (1932, op. cit.). It has since been collected occasionally on Salsette Island during and after the monsoons, though the tadpoles have so far not been reported. Recently the distribution of the species has been extended to the Dangs. Little is recorded of their habits. They apparently aestivate after the rains. McCann (1946)[1] records a male and female dormant with their legs tucked in, in the hollow of a tree.

(To be continued)

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[1] McCann, C. (1946): Aestivation of the frog *Ramanella montana* (Jerdon). *J. Bombay nat. Hist. Soc.* **46**: 404-5.

Ornithological Notes of a second trip to the Gulf of Kutch

BY

HUMAYUN ABDULALI

In the *Journal* for August 1962 (**59** : 655-658) I gave a short account of an attempt to visit some of the islands in the Gulf of Kutch. This year again, with the assistance of the Department of Fisheries (Survey & Research), Government of Gujarat, another attempt was made from the 3rd to the 6th August. Together with M. J. Pereira, Field Assistant, Bombay Natural History Society, I drove from Jamnagar to Salaya, and on the way stopped at Sikka to pick up Mohamed (who was with us on the last trip) and Dost Mohamed who has spent many years as a shikari in the Jamnagar Darbar. The latter's fund of interesting stories relating to the 'good old days' helped to while away the time. A pair of crow-pheasants seen from the car produced the following: 'The bird known as *hook-ah* builds large globular nests in inaccessible places in thorn clumps. The nests are lined with a valuable kind of grass, which thrown into a stream floats against the current!' Dost Mohamed had no personal experience of this strange 'fact' and did not know any particular use for the grass, but he had no doubt about its value. One can only wonder how such a story started[1].

The launch *Moti* which had left the previous day was to pick us up on arrival and leave on the midday tide. When we reached Salaya, there was no trace of the boat. It came in at about 3, when we were taking our lunch. I immediately sent a man down to the wharf to ensure that the boat anchored some distance off-shore but, when we walked down with our luggage a little later, we found her prow stuck in the mud and the boat rendered immobile. The next high tide was at midnight.

We spent the evening walking the shore and obtained specimens of the Lesser Flamingo (*Phoeniconais minor*) and the Reef Egret (*Egretta asha* = *E. gularis schistacea* in Ripley's SYNOPSIS). The flamingo was alone, busily feeding on the mudflats from which the tide had ebbed and which though wet only held water irregularly in small puddles. Its crop was packed with algae and held no mud.

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[1] Our editorial assistant, J. S. Serrao, informs us of a similar belief in South Kanara. According to this belief a valuable component of the crow-pheasant's nest known as *sanjivana kaddi* (life-giving herb), is separated from the other nest material by throwing the nest into a stream, whereupon the former flows upstream while the latter flows down.—EDS.

About midnight, after much pushing and pulling, we took off and hoped to reach Baida by 9 a.m. At dawn I woke to find that we had anchored at the mouth of the Salaya Creek and the tindal explained that as he had no compass he could not navigate on a cloudy night. As it was now daylight I suggested that we start off, only to find that we were again stuck in the mud. Again we lost a couple of hours and reached Baida about noon. This is a large island, mainly mangrove forest with many nullahs and creeks running into it. We waded on to a small sandy beach at one end and crossed over a low ridge on to open mudflats. A flock of Large Flamingos (*Phoenicopterus roseus*) stood on the edge of the incoming tide, while a mixed lot of ibises, egrets, grey herons, and other waders were bunched together some distance away. The creeper *Ipomoea pes-caprae* covered the sandbanks, while on the drier mudflats *Arthrocnemum indicum* Moq. and *Asparagus racemosa* grew together with mangroves.

Three large skeletons were noticed lying on the island, probably of the Hawksbill Turtle *Eretmochelys imbricata* (Linn.), the species from which the tortoise-shell of commerce is derived, but the carapaces were missing. Did they come ashore to lay their eggs?

As the tide moved in large areas were flooded and the boat was run into one of the many creeks flowing into the mangrove forest, where only the tops now showed above water. Numerous Darters (*Anhinga rufa melanogaster*), Grey Herons (*Ardea cinerea*), Reef Egrets (*Egretta gularis schistacea*), White Egrets (*Egretta* sp.), and Night Herons (*Nycticorax nycticorax*) were crowded on the trees, but there was no evidence of their nesting here. The many Reef Egrets seen were all of the dark variety, as illustrated in Plate 11 in Sálim Ali's THE BIRDS OF KUTCH (1945). Their dark legs and yellow (not *black* as in the illustration referred to) feet reminded me of the Little Egret (*E. garzetta*) which was not noted in the area—see Berlioz (1956): The Dimorphic Egrets (*J. Bombay nat. Hist. Soc.* **54** : 188-190). The (light) slaty ashy-grey birds (Sykes's *asha* from the Deccan, illustrated on Plate 52, Sálim Ali's THE BOOK OF INDIAN BIRDS, 1961), seen around Bombay (25 August to 25 May) and southwards, were said by Jerdon (1870, THE BIRDS OF INDIA : 789) to be in winter plumage, while Blanford (1895, FAUNA—Birds **4** : 391) thought they were birds of the year. In Ceylon it has not been found breeding since Layard noted it about a hundred years ago. K. M. Kirkpatrick found them breeding in the 'slaty blue phase of plumage' along the east coast near

Pulicat Lake. It is difficult to say if these were light or dark, and I think it is still to be decided if these two forms are the same or different birds.

In the mangrove we heard the Great Indian Reed Warbler (*Acrocephalus stentoreus*) calling loudly and, if we had had the time to wait and investigate, it should not have been difficult to find their nests, if they were breeding.

In the distance we saw a low mudbank, just above water, crowded with hundreds of curlew, whimbrel, and other water-birds.

On the mangroves, a little above the high waterline, there were many globular 'nests' (over a foot in diameter) made of mangrove leaves; according to a local guide they were the 'nests' of a water-rat. Here again it was not possible to stop and investigate.

We then turned towards Ajar which was now visible. Here also we landed (*c.* 4 p.m.) on a sandy beach, but the boat was almost alongside and it was possible to jump ashore. This island is about 2 miles long by three-quarters of a mile wide and rises to a height of perhaps a hundred feet. The higher areas are relatively flat and cultivated with bajri (*Pennisetum typhoideum*), and there is a permanent settlement of about six houses. A few water-birds, already mentioned, were feeding along the shore all around and the following land-birds were noted:

Nectarinia asiatica, Purple Sunbird (one male)
Pycnonotus leucotis, White-cheeked Bulbul (several)
Corvus splendens, Common House Crow (frequent, with pale necks)
Streptopelia decaocto, Ring Dove (several)
Streptopelia senegalensis, Little Brown Dove (several)
Columba livia, Blue Rock Pigeon (several)
Vanellus indicus, Red-wattled Lapwing (several)
Zosterops palpebrosa, White-eye (2 pairs in *Salvadora persica* on edge of shore)
Galerida cristata, Crested Lark (the single specimen obtained seems greyer above than any of those available for comparison in the Society's collection)

A darter flew towards us and settled on a rock 200 yards away. There was something very odd about the coloration and I saw that the underparts from chin to vent were white with three oval patches of black, arranged in a triangle, on its breast. When approached with lethal intentions, it flew away and the upper surface showed the normal colour of a darter, except that it appeared paler. I put this down to some form of albinism. A little later, I was able to collect a female which also was all white from chin to vent, excepting the sides of the belly which were dark and had slight extensions which formed two blobs of black on the belly. There was a slight trace of the white line down the sides of the neck and the upper plumage was paler and grey rather than the normal black of the adult. This specimen was perhaps a variation of the earlier bird. It contained 4 fish (*Platyglossus marginatus* and *Therapon quadrilineatus*) each about 3 inches long, and there was nothing to suggest that they had been pierced by the bill.

Further sea-ward, and not far away, lay another island Chusna, which rose high out of the water and, being uninhabited, appeared to provide possible nesting sites for gulls, terns, and other water-birds. We decided to lie alongside during the evening and to make a landing in the morning.

When we got back to the boat at dusk, she was again high and dry and the tindal was firm that it would not be possible to make a landing and take off on the same tide. My enthusiasm had ebbed with every tide and I was not inclined to risk another day. So, when we floated off in the night we made towards two low islands towards the Kathiawar shore, also visible from Ajar, with the tindal's assurance that we would be able to examine both. Here again the tide prevented our reaching them, but we landed on an exposed coral reef which lay between. Numbers of starfish both chestnut and dark brown (*Astropecten indica*) lay in the water near sea-anemones (*Stoichactis* sp.) of many colours, which when disturbed threw out fine jets of water and folding up almost disappeared into the mud. Crinoids (*Lamprometra* sp.) of various colours lay around and an orange-and-black Mantis-Shrimp (*Gonodactylus chiragra*) was picked up. An octopus disgorged several crabs, and puffer fish (*Tetrodon* sp.) swam about in pools with sandy floors. When approached, they buried themselves in the sand and could be picked up with a handful of sand. When handled, they puffed out and a companion related how, as schoolboys, they had burst the fish underfoot, making loud noises!

Except for a couple of dark reef egrets, a pair of oyster-catchers, and a Caspian tern that looked as big as a gull, there were few birds. Across a nullah which we could not cross, and perhaps a quarter of a mile away, was a large expanse of mud left uncovered by the tide. Though wet, it held no continuous sheets of water on the surface. On this mud were 20/30 each of the Large and the Lesser Flamingos, all busily feeding. The Lesser were perhaps more sociable, keeping near to another of either species. The two species have basically different diets and it was difficult to imagine how each was picking up what it wanted. The liquid mud between us prevented a closer approach for examination.

As we passed through the creek approaching Salaya, we saw many pairs of Little Terns (*Sterna albifrons*). Earlier we had seen small parties but failed to obtain specimens. One specimen shot has brownish white shafts to the primaries and is of the typical race (*S. a. albifrons*). On the last trip I obtained 3 specimens which are *S. a. saundersi.*

We reached Salaya in the afternoon and, as we decided to take the bus back to Jamnagar on the following (7th) morning, I had the evening free. The House Crows appeared to have paler necks than those in Bombay and I collected a couple. Having been told about a jheel on the other side of the town, I walked over to investigate. A large sheet of water bordered with tall weeds is separated from a tidal creek by a large bund over which runs a motor-road. Close by is a Jain temple and apparently shooting is prohibited. Several flamingos (Large) were feeding in the tidal nullah, while a party of about 15 stood together in the lake some 30 yards from the road. Those feeding in the creek constantly tapped the bottom with their feet, presumably to disturb their food at the bottom. A man with a *lota* walked to less than 20 yards of a flamingo and squatted, each unmindful of the other.

As we watched, a considerable stream of Common Sandgrouse (*Pterocles exustus*) in twos and small parties of 8 to 10 flew chuckling overhead. On the lake were many Spotbill Duck in pairs, often several together. In the shelter of the reeds I walked to within 20 yards before they rose, the larger drakes quacking while the ducks were silent. There were many Purple Coots (*Porphyrio poliocephalus*) which ran along the shore and flew on to the reeds when disturbed. They settled sideways on the reeds, behaving like gigantic warblers. One bird with a grey head and without the red patch on the crown was apparently a full-fledged young.

The lake also held many Dabchicks (*Podiceps ruficollis*), some Common Coot (*Fulica atra*), a few Whistling Teal, and a single Cotton Teal drake (*Nettapus coromandelianus*). The Coot were a little earlier than the first recorded by Sálim Ali at Bhuj, Kutch (12 August), but Dharmakumarsinhji has taken nests with eggs at Bhavnagar in August.

A single Yellow Bittern (*Ixobrychus sinensis*) flew from one patch of grass into another. A number of large terns were seen settled on the mud in the tidal area. I walked up and most of them, all Gull-billed Terns (*Gelochelidon nilotica*), flew away leaving half-a-dozen birds behind. These when glassed were seen to have brown wings and large red bills. As they flew away, their long pointed wings confirmed that they were Skimmers (*Rhynchops albicollis*). This species is not included either in Sálim Ali's BIRDS OF KUTCH or in his paper 'The Birds of Gujarat' (*J. Bombay nat. Hist. Soc.* **52** : 374-458, 735-802) but M. K. Himmatsinhji of Kutch saw it in Laija Creek west of Mandvi in August 1957 (*J. Bombay nat. Hist. Soc.* **54** : 190) and Dharmakumarsinhji has several records in his BIRDS OF SAURASHTRA, p. 222. As I returned to the bund to watch the duck and other birds, several parties of 10/15 Skimmers flew leisurely across the lake, some 10 feet above the water.

A single swallow (*Hirundo rustica*) flew past. Though this did not 'produce winter' or even autumn, there can be little doubt that many of these 'winter' visitors arrive much earlier than is generally believed. I was unable to obtain evidence of any of them staying over or breeding in the area, but it was not possible to visit all the islands, nor to be certain that some of the water-birds did not nest there during May, June, and July. If a research scholar were placed on Ajar for the duration of the monsoon, he would undoubtedly get some useful information. Sailing boats are available and, with no need to worry about a tide or two, it should be possible to visit all the islands. The cost would be small but time and effort must be forthcoming. The island of Ajar also appeared to be of just the right size and character to permit a really accurate census of its birds and an assessment of the relations between individuals of the same and different species. Ecological work would also be of almost laboratory convenience and yet under entirely natural conditions.

During the two days we were actually in the field, Pereira worked hard. Three flamingos, two Reef Egrets, and several other birds are not easily skinned in a small and crowded cabin. The Lesser Flamingo is an addition to the Society's collection, no other specimen being available.

The Fisheries Department of the Government of Gujarat was helpful and co-operative, and I must record my thanks and gratitude to them. I am sure that they will extend their co-operation to any person who makes another effort in that direction. If a longer trip is envisaged, it would be worthwhile working together with somebody who can handle the invertebrate fauna of the coral reefs and the mudflats. There appear to be unlimited possibilities in this direction, where almost no work has been done. I would advise that a small boat be kept available—a rubber dinghy may be sufficient. It will permit movement and work during many hours which are otherwise spent waiting for the tide.

Obituaries

B. B. OSMASTON, C.I.E.

We record with regret the death on the 5th September 1961 of Bertram Beresford Osmaston.

Bertram Beresford Osmaston, known to many in India as 'B.B.', was born at Yeldersley Hall, Derbyshire, in 1867, the ninth of a family of fifteen, two of whom survive him. He was educated at Harborne Vicarage Private School, Trent and Cheltenham Colleges, and the Royal India Engineering College at Cooper's Hill, where those entering the Indian Forest Service were trained in those days. Passing in and out the first of his year, he was made a Fellow of the College.

B.B. came out in the Service in 1888, served in the United Provinces (including Dehra Dun Forest College), Bengal, the Andaman Islands, and Burma, and retired as Chief Conservator of the Central Provinces. His meritorious service was acknowledged by Government by the award of the C.I.E.

After retirement he lived with his family for some time at Srinagar in Kashmir, and for the remainder of his life at Oxford.

One of the band of distinguished officers of the Indian Forest Service whose interests covered almost every aspect of Indian natural history, B.B. was primarily an ornithologist and recorded his observations of bird life in several regions of India in numerous papers contributed to the Society's journal.

Not knowing what it was to be afraid, B.B. had more than his share of dangerous encounters with wild animals. The first came at the age of 21, when he had not yet seen a tiger outside a zoo. With Hansard, an equally young companion, he 'stalked' a man-eating tigress in the afternoon, imagining that she would be asleep. Instead, the tigress did the stalking and jumped on Hansard. B.B.'s first shot turned her attention to him and a fortunate shot from his second barrel killed her in the midst of a furious charge.

In 1892, B.B. married Catherine Mary, daughter of General and Mrs. Hutchinson, and they had a long and happy married life till her death in 1960. One son was killed in the First World War. Two sons and three daughters survive.

A list of his contributions to the *Journal* is given below:

On the nidification of certain birds not previously recorded. Vol. **9** : 190.

Birds nesting in the Tons Valley. Vol. **13** : 542.

Curious course taken by the Hyoid Cornua or tongue muscles in certain woodpeckers. Vol. **14** : 587.

Notes on the nidification of some birds, the nests and eggs of which have not been previously described. Vol. **14** : 815.

The Himalayan Nutcracker. Vol. **14** : 818.

The Chestnutheaded Shortwing (*Oligura castaneicoronata*). Vol. **14** : 819.

Notes on the breeding of certain birds near Darjeeling. Vol. **15** : 510.

A visit to Narcondam. Vol. **16** : 620.

Notes on the Andaman Island birds with accounts of the nidification of several species whose nests and eggs have not been hitherto described. Vol. **17** : 156, 486.

Mangroves and Paroquets. Vol. **17** : 240.

A visit to Barren Island, Andamans. Vol. **18** : 357.

Strange behaviour of certain birds when in possession of strong smelling insects. Vol. **19** : 752.

The supply of water to young birds in the nest. Vol. **19** : 753.

The Himalayan Greenfinch (*Hypacanthis spinoides*). Vol. **20** : 852.

Notes on the cuckoos in Maymyo. Vol. **24** : 359.

Nidification of the Green Shrike-Tit (*P. xanthochloris*). Vol. **24** : 593.

Pied Crested Hawk-Cuckoo (*C. jacobinus*). Vol. **24** : 821.

Owl caught on a thorn. Vol. **24** : 822.

Breeding of the Banded Crake. Vol. **24** : 824.

Further notes on birds nesting in the Tons Valley. Vol. **25** : 493.

Further notes on Indian Nightjars. Vol. **27** : 948.

The White-spotted Fantail Flycatcher (*Rhipidura pectoralis*). Vol. **28** : 282.

The Crested Swift (*Macropteryx coronata*). Vol. **28** : 283.

Birds of Pachmarhi. Vol. **28** : 453.

Predaceous habits of the Common King Crow. Vol. **28** : 546.

The occurrence of the Blue-bearded Bee-eater (*Nyctiornis athertoni*) in the C. P. Vol. **28** : 805.

Woodpecker occupying nesting box. Vol. **28** : 1137.

Supposed occurrence of the Ermine in India. Vol. **29** : 277.

Bird life in Gulmarg. Vol. **29** : 493.

The trinomial system of nomenclature as applied to Indian birds. Vol. **29** : 556.

Supplementary notes on some Indian birds. Vol. **26** : 424.

The Shikra (*Astur badius*). Vol. **29** : 560.

Birds nesting in the Dras and Suru Valleys. Vol. **31** : 186.

The Rock Horned Owl in Kashmir. Vol. **31** : 523.

Clicking noise made by Muntjac. Vol. **32** : 795.

A tour in further Kashmir. Vol. **34** : 108.

Some Andaman birds. Vol. **35** : 891.

Do birds employ ants to rid themselves of ectoparasites? Vol. **39** : 182.

The large Red Flying Squirrel *Pteromys inornatus*. Vol. **49** : 114.

EDITORS

R. F. STONEY

It is with deep regret that the death is recorded of R. F. (Dick) Stoney, an old and valued member of the Society, at Ootacamund on the 27th of August 1963.

Dick Stoney was born at Coonoor in the Nilgiris in 1876 and was educated at Cheltenham College, England. The name Stoney has long been associated with engineering, Dick's father E. W. being at one time the Chief Engineer of the old Madras Railway, whilst the 'Stoney Patent Sluice' may be found on the various River Nile projects. Following this tradition, Dick was posted in 1896 as Executive Engineer, P. W. D., Madras, from which Service he finally retired as Chief Engineer. The most notable of his works are the Mettur Dam and the Observatory at Kodaikanal.

It was always a pleasure to sit in Committee with Stoney, a man of many parts and varied interests, be the subject wild life control, the local library, or any of the many public bodies on whose committees he served. A concise analytical mind, a very dry sense of humour, the gift of Irish ancestry, and a fund of anecdotes always rendered discussion of the driest balance sheet or administrative problem a rare form of relaxation rather than a tedious duty.

Recognised throughout the philatelic world, Stoney was a member of the Indian Philatelic Advisory Committee and a Committee Member of the Philatelic Society of India. At an Exhibition held in connection with the centenary of the Indian Post Office in 1954, he was awarded the President's Gold Medal for the best collection of stamps of the Indian States.

An authority on Indian mythology, he was justifiably proud of his collection of bronzes portraying the many deities and symbolical figures associated with this time-old subject. The collection, worthy of a place in the best of Museums, was not just an accumulation of items gathered at random. The various pieces were the subject of loving care in selection, each with a purpose. To the untutored eye many had a sameness, but it was fascinating indeed to hear unfolded the various aspects of design, ornamentation, purpose, and even manufacture by an undoubted master of his subject. Greater interest was added by the fact that Stoney respected the beliefs which prompted the creation of such objects of beauty.

My personal association with him commenced only some fifteen years ago when, as a newcomer to Ootacamund, I had occasion to seek his guidance, as the local authority, on the chances of obtaining some woodcock and duck shooting. Without stint, I was given the benefit of years of experience with regard to the best waters and how to tackle them. If woodcock were in the Hills, Stoney knew of it and the location was freely given to me and others and not kept a closely guarded secret. Subsequently, I enjoyed many hours of unforgettable sport in the company of this grand, unselfish, old-timer.

In 1959 Stoney had to have his right leg amputated and, as may be expected of his type, the inability was regarded as tedious but no real detriment to the pursuit of his favourite sport. A special swivel chair was constructed and he continued to shoot the Mysore and Gundalpet tanks right up to his last trip in April 1963, some four months before his death.

We, of a younger generation, feel deeply the passing of such men for, without doubt, we shall never see their like again.

Gentleman, scholar, sportsman, friend, Dick Stoney will be missed by Indians and Europeans of all stations alike.

Stoney leaves a son and a daughter to whom, we of the Society and on behalf of mutual friends offer our sincere condolences.

H.L.T.

Reviews

1. BIRDS OF THE WORLD. By Hans Hvass. Translated into English by Gwynne Vevers. pp. 211 (22.5×16 cm.). Over 1100 birds illustrated in full colour by Wilhelm Eigener. London, 1963. Methuen & Co. Ltd. Price 21*s.*

The earliest known students of bird life are perhaps the neolithic men who painted the Spanish caves over 8000 years ago. From the time of Aristotle onward, this interest in the winged world helped men in interpreting the basic principles of evolution, for birds are extremely sensitive to their surroundings and a comparative study of the birds of the world offers valuable clues to anyone studying the mysteries of speciation.

Hans Hvass's BIRDS OF THE WORLD is a positive step towards a sound understanding of the feathered world. Of about 8600 living species, the book deals with 1100, some common and some rare, drawn from all over the world and from all of the 27 living natural orders. They are split up into some 120 families and arranged from the highest developed species downward. The chapter on each order opens with an account of the general characteristics, number of species, and centres of abundance of the order. This is supplemented by a brief discussion of the range, relationship, and special adaptation of each family. The English and Latin names of the birds along with the total body length in inches of each bird are given. All the birds discussed are illustrated. The text is limited to a few lines on the range and food for most of the species, but more detailed information about the appearance, calls and breeding habits, etc., is provided for some of the lesser-known birds.

The author has given prominence to the birds of Europe and the New World, touching about 200 and 300 species respectively from these regions. Tropical birds are represented by the characteristic species.

The primary object as stated in the foreword is to show the enormous range of form and colour in birds. This is achieved in a simple and efficient manner refreshingly free of many technical terms.

The illustrations generally are good in spite of a tendency of many to look too dark in the reproduction. The usefulness of the book as a field-guide could have been enhanced by bringing more of the habitat into the pictures.

D. N. MATHEW

2. FOREVER FREE : ELSA'S PRIDE. By Joy Adamson. pp. 192 (24×17 cm.). Numerous photographs in colour and black and white. London, 1962. Collins & Harvill Press. Price 30*s*.

BORN FREE told how the lion cub Elsa grew to maturity under the fostering care of the author Joy Adamson and her husband George. LIVING FREE continued the story. Elsa, now living free and mated to a wild lion, brought her cubs to the Adamsons. Thereafter Elsa and her cubs gravitated between the wild and the camp of the Adamsons, Elsa mixing freely with them as before, her cubs living on the fringe with only Jespah reconciled to their presence and the other two fighting shy and at most tolerating them. When FOREVER FREE begins the cubs are a little over a year old and the peace of the 'family' has been disturbed. The African District Council has decided that lions, so used to human company, may become a danger and has directed that they must be removed from the area in which, with the approval of the local authorities, Elsa was released two and a half years before. After a prolonged search George Adamson reported a possible though not very inviting home in the region of Lake Rudolf, which involved the construction of a sixty-mile road to carry the lions there. While the Adamsons were contemplating this possibility and Joy Adamson was prospecting the south for something more suitable, Elsa complicated matters by dying. It now became difficult to keep in touch with the cubs. They wandered and, driven by hunger, attacked the goats of the tribesmen. The Adamsons saved their lives by liberally and frequently compensating the tribesmen, and with immense pains attracted the cubs back to the camp. With Elsa's death the idea of a home in the wild had to be given up, and the Adamsons accepted gladly the offer of a home in the Serengeti National Park. With what patience and perseverance the cubs were captured, how they were transported by road over 700 miles of difficult country, how they were released at Serengeti and found a place to their liking, how for some months the Adamsons fed them with game killed outside the Park, how their continued presence in the Park and their tending of the cubs was forbidden, how Joy Adamson stayed on as an ordinary visitor to watch over the fortunes of the cubs, and how the Adamsons made frantic but unsuccessful efforts to persuade the Park authorities to permit an operation to remove from Jespah's rump a tribesman's arrow-head which remained stuck in it all this time make absorbing reading. A lover of wildlife and a keen observer, Joy Adamson has much else to tell that is of interest to us. The book is illustrated with beautiful and numerous photographs of the lion cubs and other wild animals.

D.E.R.

3. BEE KEEPING IN INDIA. By Sardar Singh, Ph.D. (Cornell). pp. 214 (22×14.5 cm.). New Delhi, 1962. Indian Council of Agricultural Research. Price Rs. 8.

Bee keeping received a great fillip in India when the Village Industries Association gave it a high place among village industries. No doubt bee keeping has been practised in India for a very long time but it was carried on haphazardly by a few in an unorganised manner. A fairly good literature was available on the subject such as Bulletin No. 10 of the Mysore Agricultural Department, 1933, and Miscellaneous Bulletin No. 6 of the Imperial Council of Agricultural Research, New Delhi, 1936. In more recent years the *Indian Bee Journal* published in Ramgarh (U. P.) has been doing very useful work in this field, giving information regarding the latest methods of bee keeping, honey disposal, statistical data, etc. In spite of these and other such books and journals bee keepers often found themselves at a loss, in the midst of their success, by the puzzling behaviour of bees, and because of this one will find bee keeping being given up in villages where it had become very popular a few years back. Yet bee keeping can be a steady and more profitable industry if properly looked after, as shown by the statistics in the book under review. There seems to be good scope for improvement and for increasing one's income through this source in India. Any help in achieving this result should be welcome to the bee keeper.

The author treats the subject fairly thoroughly giving his reader an idea of what the bee is, its general way of life, its temperament, and its whimsicalities. The anatomy and physiology of the insect, the various species of bees available with the temperament of each and their economic values, the castes into which a bee colony is divided, the duties of each caste and how to recognise them from the younger stages to the adult, as treated in this publication are all useful information. Chapters dealing with how to acquire bees, their seasonal management, and miscellaneous manipulation will help bee keepers in dealing with their difficulties. A bee keeper's knowledge will be incomplete without knowing the enemies and diseases of bees and their combs, how the honey and bees-wax are formed and how they can be gathered and disposed of. All these subjects are treated. Additional knowledge about the usefulness of bees as pollinating agents will make the bee keeper proud that by keeping bees he is helping nature to perpetuate its species. All this information, along with the chapter on bee pasture, consolidated in one place in fairly great detail with appropriate illustrations makes this publication very useful to amateur and professional bee keepers alike. While going through the chapter on pasturage one feels disappointed that the flowering plants and trees that we ordinarily have in our areas are not sufficient to keep the bee colony going throughout the year. The suggestions given at the end of the chapter, however, are heartening and worth trying.

The reviewer, however, would like to suggest a few points for incorporation in the next revised edition, as he feels that they would enhance the usefulness of the book. They are: (*a*) in fig. 13 the worker, drone, and queen cells are not distinguished by any signs or marks: this should be done; (*b*) in figs. 29 and 30 photographs of different appliances and equipment are shown without indicating which is which: they should be pointed out; (*c*) in fig. 80 the stigma is shown by an arrow mark and the explanation on it says 'anthers ready to discharge pollen dust upon waiting stigmatic surface which is sticky when ripe': rather it ought to read 'Stigmatic surface which is sticky when ripe waiting to receive pollen dust from the anthers'; (*d*) a few contradictory statements will have to be rectified, e.g. (i) on page 20 it is said that the differentiation in the workers and queens is not due to quality but quantity fed to the larva and on page 28 a statement says that the composition of food given to the grubs destined to be queens, workers, and drones is somewhat varied; (ii) on page 176 the first paragraph contradicts the views expressed in the last paragraph about honey as food; and (*e*) the scientific names of two insects are misspelt on pages 167, 168, etc.—the 'death's head' moth is *Acherontia* and not *Achrontia* and the praying mantis is *Creoboter* and not *Creobrator* as spelt by the author.

Recently Phadke & Sinha have stated in the *Indian Journal of Entomology*, Vol. 25, p. 86 (March 1963), that the eggs of *Apis indica* Fabr. laid in an artificial comb foundation are nonviable. This factor will have to be studied carefully as a bee keeper has to depend on artificial comb foundations for his hive.

The Appendix at the end of the book is full of very useful information. It mentions, with addresses, Indian and foreign (1) bee keeping organisations, (2) bee keeping periodicals and books, (3) bee supply organisations, (4) courses of training in bee keeping, and (5) suppliers of containers for honey.

In short the book serves as a handy reference book for those interested in bee keeping.

The price of only Rs. 8/- is very reasonable.

N.T.N.

4. PROCEEDINGS OF THE SUMMER SCHOOL OF BOTANY—DARJEELING 1960. Edited by P. Maheshwari, B. M. Johri, and I. K. Vasil. pp. viii+522 (23×16 cm.). 8 photographs. New Delhi, 1962. Ministry of Scientific Research & Cultural Affairs, Government of India. Price Rs. 25.

This is a report of the first Summer School in Botany in the series of Summer School meetings in various subjects initiated by the Ministry of Scientific Research & Cultural Affairs, Government of India. The Summer School under review was held at Darjeeling from 2 to 15 June 1960. The inauguration was graced by the presence of the Chief Minister of West Bengal and the Deputy Minister as well as the Joint and Deputy Secretaries of the Government of India, Ministry of Scientific Research & Cultural Affairs. The proceedings as a whole are reviewed here, not the individual papers which are admirably edited by a most capable team of Indian botanists.

The Summer School was directed by Prof. P. Maheshwari and organised by Dr. B. M. Johri. Thirty-six botanists attended, including two foreign delegates, one from the U.S. Embassy, the other a visiting Professor from Argentina. Almost the whole of India was represented, four delegates from Delhi University (including the Director and the organiser), three each from the Botanical Survey of India and Andhra and Utkal universities, two from Madras, and one each from the universities of Agra, Allahabad, Bombay, Calcutta, Gauhati, Gorakhpur, Gujarat, Karnatak, Kerala, Lucknow, Mysore, Patna, Poona, Punjab, Rajasthan, Saugor, Sri Venkateshwar, and Vallabh Vidyapeeth. The Indian Botanical Garden, Sibpur, was also represented. Institutions like the Indian Botanical Society, the Botanical Society of Bengal, Bombay Natural History Society, the National Botanical Garden, Indian Agricultural Research Institute, and Birbal Sahni Institute of Palaeobotany were not officially represented.

The delegates who attended sacrificed their vacations for the stimulating but heavy work of lecturing and discussing, presumably as guests of the Government of India. They stayed in the same hotel which allowed them 'long informal and group discussions which were very helpful'. According to the programme given in Appendix II, there were 59 talks, 3 film shows, 3 excursions, 1 at-home (Governor's), and 1 dinner (farewell), and 7 hours of special discussions. By any standard, this is an achievement which speaks very highly of the organising talent of those who were in charge. This publication is another proof of the tremendous amount of work involved. In all 48 papers and one report of the discussions (Appendix III) have been published. Of the 11 which were not published, 6 were after-dinner talks. The papers on tissue culture and embryology stand out by their brilliance, and those on algae and micro-organisms by the ingenuity and the scope of application of the scientific principles involved. All the other papers, embracing various topics in plant-physiology, anatomy, ecology, geography, viruses, cytology, genetics, systematics and morphology of angiosperms, pteridophytes, fossils, etc., are well written and more or less represent the current trends of botanical research in India.

Some of the papers took as much as two hours and two instalments, and at times there were as many as nine papers or talks a day. No wonder 'coffee' figures as a separate item in the programme. Barring the two Sundays, this stimulant was consumed on eleven of the twelve working days; curiously, it was not needed after the talk on 'Botanical Nomenclature'! Although a tea estate (Happy Valley) was visited, there is no evidence of tea consumption by the botanists —perhaps by its sheer abundance it did not call for special mention!

Eleven senior botanists graced the chair, several of them more than once except the seniormost (the Director), who never accepted this honour!

The serious student of botany feels very happy to go through these very valuable papers but sadly misses the most interesting discourses that followed the reading. The majority of such reports from abroad are accompanied by lively (and duly edited) post-mortems. The views and sentiments expressed as a result of two days of solid discussions concerning teaching and research in Botany in India are admirable. One would have liked to know if effective machinery was established to bring these laudable objectives to fruition. The delegates seem to have noted several institutions in the U. K. and Germany dedicated to research in plant physiology, genetics, mycology, etc., but they failed to take note of the applied aspects of the research programmes undertaken there and of the innumerable short courses in applied botany such as in horticulture, plant protection, forestry, conservation, quality control of vegetable produce, etc., that would in effect promote the employment potential and attract better talent to take up the study of Botany.

This reviewer agrees with the delegates that the Darjeeling Summer School stimulated interest in the work of delegates who attended. It therefore served its purpose very admirably. It is earnestly hoped that the subsequent reports of the Summer Schools in Botany will be similarly published for the benefit of those who cannot be invited. It may even be a good idea if these meetings can be thrown open to the 'unprivileged', at their own expense, to attend as observers, without being allowed to participate in the proceedings.

P. V. BOLE

5. THE ASCLEPIADACEAE & PERIPLOCACEAE OF BOMBAY.

By H. Santapau and N. A. Irani. pp. iv+118 (24.5×16.5 cm.). 12 plates. Bombay, 1960. University of Bombay. Botanical Memoir No. 4. Price Rs 7.

This is an excellent little publication that gives a short sketch of this group of plants since its inception in '*Pentandria monogyna* and *P. digyna*' of Linnaeus to the present-day concept. It gives the synopsis of the record of this group in the region under survey, viz. the former Presidency of Bombay which included parts of the present States of Gujarat and Mysore. It also gives a brief account of the economic uses of a few of these plants as recorded in literature.

The main part of the publication consists of carefully drawn diagnostic characters with appropriate comments about 25 genera of the Asclepiadaceae and 3 of the Periplocaceae. The specific descriptions of 61 taxa are very critical and are based on literature study as well as on careful analyses of the plants in the field and the laboratory. All the data given in the book are authentic as they are derived from personal observation and based on examinations of collections from various herbaria, a list of which is appended under each species. In most cases, critical notes regarding nomenclature, description, and uses are also included with appropriate references.

The keys to genera and species are artificial and are meant to assist the systematist to arrive at the correct identity of the taxa of this difficult group of plants. Line drawings of 12 species, executed to scale, are highly commendable. It seems a great pity that all the 61 taxa could not be represented by diagrams, perhaps in consideration of the high cost of printing.

This is a very ideally executed project in systematic Botany as a partial revision (in preparation to a complete revision) as stated by the authors. It has certainly brought our knowledge of this group of plants up to date. A more complete and broad-based revision could be best achieved by compiling such limited revisions of various botanical or geographical areas. It is often thought that partial revisions are not wise to undertake (hazardous to reputation!) on account of their intrinsic limitations. It is also said that full facilities and the required critical materials may not be available at university level. However, as long as these limitations are recognised and appreciated, it is safe to take up this type of project. Many young workers can be trained in methods of plant taxonomy and many significant facts can accrue out of repeated field studies on smaller numbers of species in limited areas. This publication is an eminent example of such efforts and is worthy of emulation by other workers in different parts of India. Data brought out in such studies form a good basis for further work in the field of morphological, ecological, physiological, and genetical studies. It can also be added that such studies will play an important role in evolving quantitative surveys of plant species if and when necessary.

The senior author and his students have carried out similar studies of several other families, notably Apocynaceae, Convolvulaceae, Solanaceae, Rubiaceae, and Verbenaceae. Many of the plants of these families are proved to be of economic value and the others may have potential interest in view of the gradual realisation of the relationship of plant taxonomy and chemical constituents. It is earnestly hoped that all this work will also be published by the University of Bombay. Such studies are no doubt a great service to the cause of science and the utilisation of national wealth. Both the authors and the publishers deserve our thanks for bringing out this excellent little book.

P. V. BOLE

6. NAMING THE LIVING WORLD : AN INTRODUCTION TO THE PRINCIPLES OF BIOLOGICAL NOMENCLATURE. By Theodore Savory. pp. xiii+128 (22×14 cm.). London, 1962. The English Universities Press Ltd. Price 12*s*. 6*d*.

One of the primary requisites for a student of biology is at least a basic knowledge of the principles of nomenclature, a subject, as the author rightly states, so often overlooked by authors of biology text books. Many mistakes which editors so frequently come across in notes on taxonomy could have been avoided if the authors had an adequate knowledge of these principles. This need is fulfilled comprehensively by this small and well-written book.

The three sections of the book cover the principles of Nomenclature, Codes of Nomenclature, and Practice of Nomenclature. In the first section are described the need for names, the languages in use, the nature of the names in use, and the methods for forming new names. The second section describes the rules of nomenclature and the codes of several disciplines of biology. The third section describes the mistakes to be avoided, and the methods to be used in the practice of nomenclature.

Taxonomists would do well to refresh their memory occasionally with a reading of the last section of the final chapter describing the 'Essentials of a Code'.

A book which should find a place in the libraries of all institutions teaching and doing research in Biology.

J.C.D.

Miscellaneous Notes

1. NOTE ON THE BREEDING SEASON OF *RHINOPOMA HARDWICKEI* GRAY

Little is known about the breeding of the bat *Rhinopoma hardwickei* Gray in India. Brosset (*J. Bombay nat. Hist. Soc.*, 1962, **59** : 27) says of this species: 'No young were seen in October, November, December, February, March or April. Females dissected in March or April had no fœtuses . . . From these negative observations we can infer that pregnancy and birth takes place between the end of April and the end of September, June being the time of parturition. The existence of young obviously born in June, in the B. N. H. S. collections, supports this deduction. Reproduction, however, appears to be very restricted.'

In view of the scarcity of information about the breeding of this species, it seems worthwhile to record the following observations.

There is a colony of *Rhinopoma hardwickei* in a cave on a hill just outside Vellore, North Arcot District. On the 1st July 1963, 25 specimens were captured from this colony in a mist net. Of these 17 were adults, 12 females and 5 males, and 8 were young, 3 females and 5 males. The eight young were roughly one-third to one-half the size of the adults and were clinging to their mothers in an inverted position. On a previous occasion, in December 1962, 7 individuals were captured, 5 females and 2 males. None of the females was carrying young on this occasion. Brosset's assumption that parturition takes place in or about June is therefore supported for this part of the country at least.

VELLORE FIELD STATION OF THE
VIRUS RESEARCH CENTRE, POONA,
CHRISTIAN MEDICAL COLLEGE HOSPITAL,
VELLORE,
November 13, 1963.

R. REUBEN

2. BAT *MEGADERMA LYRA* GEOFFROY CAUGHT IN A *ZIZYPHUS* BUSH

In May 1962 I was looking for bears along a rocky hill-side in the Wamanpalli Forest Block, Central Chanda Division, Maharashtra. I was accompanied by Humayun Abdulali and two men, and our tactics were to work along rocky hill faces searching for caves and hollows where bears might be lying up in refuge from the extreme afternoon heat. Any likely caves or hollows were stoned in hopes of flushing a bear. The hill-sides were excessively hot, uncomfortable, and thorny. At the entrance of one low horizontal cave we saw a bat (*Megaderma lyra* Geoffroy) whose wings were caught on the curved thorns of a small bush of *Zizyphus* sp. about two feet above ground level.

THE BRITISH COUNCIL,
21, JOR BAGH,
NEW DELHI 3,
June 25, 1963.

JOHN GOATLY

[Among other prey this species feeds on terrestrial vertebrates and its hunting flight is low 'almost touching the ground' (A. Brosset, 1962, *J. Bombay nat. Hist. Soc.* **59** : 591). This may explain how this bat got caught in the bush. It is interesting to note in some parts of India bats are caught by suddenly thrusting into their roosting places sticks with *Zizyphus* twigs tied on them. G. M. Allen (1939, BATS, p. 291) says that several cases are on record of bats perishing by flying too close to the hooked burrs of burdocks and getting hopelessly entangled in them.—EDS.]

3. OCCURRENCE OF THE EUROPEAN FREETAIED BAT [*TADARIDA TENIOTIS* (RAFINESQUE)] (CHIROPTERA: MOLOSSIDAE) IN INDIA

Previous records of the molossid genus *Tadarida* from the Indian sub-continent refer only to *T. aegyptiaca*, *T. tragata*, and *T. plicata*. Through the courtesy of Mr. J. C. Daniel, Curator, Bombay Natural History Society, I am able to report the occurrence of *T. teniotis* (Rafinesque) in India. The specimen on which this report is based was obtained by Brother A. Navarro, S.J., of St. Xavier's High School, Bombay, at Kurseong, Darjeeling District, at an altitude of 5454 ft., on 10 March 1963, and will remain in the possession of the Bombay Natural History Society. Mr. J. C. Daniel considered that this specimen represented *T. teniotis*, but in the absence of comparative material submitted it to the British Museum (Natural History) for further examination, which has confirmed this identification. This species differs from *T. aegyptiaca*, *T. tragata*, and *T. plicata* in greater size, with the forearm 57-64 mm. in length [Lewis & Harrison, 1962 : 479 (in part)] : in *T. aegyptiaca*, the largest of the species hitherto recorded, the length of the forearm does not exceed 54 mm. (Siddiqi, 1961 : 118; Hill, 1961 : 36; Brosset, 1962 : 707). It may be distinguished from *T. aegyptiaca* and *T. plicata* by the usual presence of six and not four lower incisors, although occasionally one or both members of the outer pair may be absent. The anterior upper premolar (pm^2) in *T. teniotis* is comparatively large and is situated more nearly in the line of the tooth row than is the small anterior upper premolar of *T. aegyptiaca*. The palatal branches of the premaxillae are absent in *T. teniotis* and the palate conspicuously emarginated anteriorly while in *T. plicata* the palatal branches of the premaxillae are present and the palate has no conspicuous anterior emargination. In the details of its dentition *T. teniotis* resembles *T. tragata*, which on this account was referred by Wroughton (1919 : 731) to a *teniotis* section of *Tadarida* distinct from an *aegyptiaca* section and which was thought by Hill (1961 : 35) to be possibly related to *T. teniotis*. However, from the measurements given by Dobson (1876 : 181; 1877 : 721; 1878 : 424) and as represented in the collections of the British Museum (Natural History) by the specimen listed from the Malabar coast by Dobson (1878 : 425), *T. tragata* is considerably smaller than *T. teniotis*, with a forearm approximately 50 mm. in length (from Dobson). Assessment of the affinities of *T. tragata* requires further study of the type specimen and of the other specimens listed by Dobson (1874 : 143) in the original description, all preserved in the Indian Museum, Calcutta.

It is difficult to allocate the Indian specimen to any one of the currently accepted subspecies of *T. teniotis*. Although known from a number of localities in southern Europe, Egypt, south-western Asia, and the Far East, records from the central part of this wide range are few. The nominate subspecies *T. t. teniotis* (Rafinesque) is found in southern Europe and according to Ellerman & Morrison-Scott (1951 : 134) extends to the Caucasus and Turkestan, although Kuzyakin (1944 : 108) made no subspecific allocation of central Asian specimens. The slightly paler and greyer subspecies *T. t. rueppelli* (Temminck) occurs in Egypt and south-western Asia (Lewis & Harrison, 1962 : 476). A very dark subspecies, *T. t. coecata* Thomas is known from Yunnan, while the dark subspecies *T. t. insignis* (Blyth) occurs in eastern China, Korea, and Japan and has been quoted from as far north as Vladivostok (Satunin, 1914 : 44). Dorsally, the Indian specimen is brownish and is similar to *T. t. teniotis* or to *T. t. insignis*. Ventrally, however, it lacks the brownish tinge evident in these subspecies and is paler and more greyish, in this respect resembling *T. t. rueppelli* but slightly darker. It is much lighter in colour both dorsally and ventrally than the type specimen of *T. t. coecata* and it seems evident that determination of the subspecific status of *T. teniotis* in the Indian sub-continent must await the advent of adequate series of specimens. Measurements (in mm.) of the Indian specimen (the skull has been damaged and the entire base of the braincase is missing): length of forearm 64, interorbital width 4.9, m^3-m^3 (outside alveoli) 9.5, c^1-c^1 (outside alveoli) 5.9, c-m^3 (alveoli) 8.8.

DEPARTMENT OF ZOOLOGY,
BRITISH MUSEUM (NAT. HIST.),
CROMWELL ROAD,
LONDON, S. W. 7,
November 19, 1963.

J. E. HILL

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4. DO GOATS EAT CRABS ?

The Andaman and Nicobar Islands are noted for the paucity of indigenous mammalian life and, barring the native pig, no other large mammals are known to occur there. Therefore, when these islands caught the eye of civilisation, man tried to fill the faunal lacuna left by Nature! New creatures were introduced for food and fun. Among the wild animals introduced in these islands, the most important is the spotted deer, a few of which released over a hundred years ago have now multiplied to such an extent as to be a nuisance to cultivation and forestry. The spotted deer is now a pest in the Andamans as much as the rabbit in Australia.

More interesting, however, is the domestic goat, small herds of which were left on Barren Island, a volcanic island about 50 miles east of the main group, and other tiny isolated islands in the Duncan Passage. These islands do not have any permanent source of fresh water, and have little vegetation to support the goats, with the result (it is said) that their dietary habits are considerably modified.

The goats left on these islands, it is stated by the inhabitants of Port Blair, have taken to drinking sea-water, and a friend informs me that the flesh of these goats tastes different from that of the fresh-water-drinking goats. It is further alleged that the goats of Barren Island, which was active till the beginning of the present century, eat crabs! The crab-eating trait of these goats, if confirmed by authentic evidence, should prove of great biological interest.

Changes in the dietary habits of animals occur frequently in nature. Literature is full of instances (mostly of insects) of such changes. Thus, most of the dangerous insect pests of cultivated plants originate through changes in food preferences of formerly harmless species. E. Mayr (1942, SYSTEMATICS AND ORIGIN OF NEW SPECIES, p. 209) cites the case of an English willow bug (*Plesiocoris rugicollis*) which turned to apples in 1918 and has become a serious pest. Sometimes the introduction of a new faunal element in an area affects the dietary habits of some of the original inhabitants of that area. The case of New Zealand Parrot, the Kea (*Nestor notabilis*), is famous in this connection. This species fed largely on insects and vegetable matter before the island was colonised by the Europeans. After sheep had been introduced in the island, the Kea developed a taste for their meat by feeding on dead sheep. Later, it began to attack live animals.

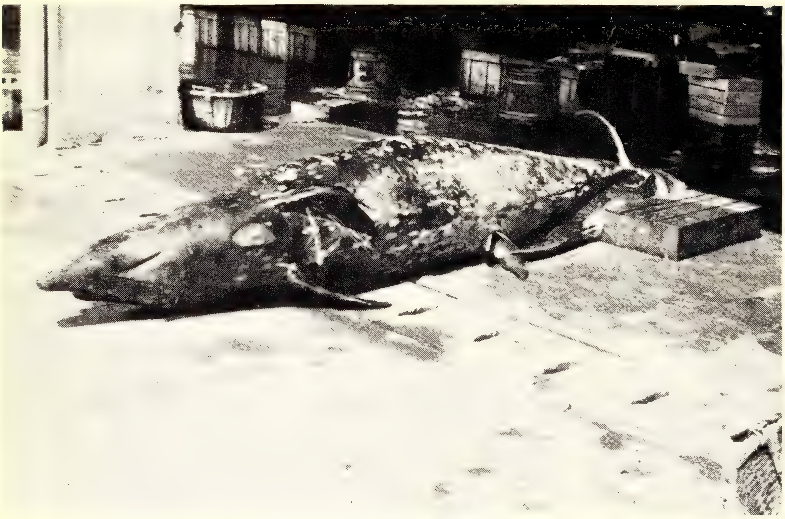
More interesting, in the present context, is the case of the Spotted Deer (*Axis axis*) in the Sunderbans feeding on crabs (*Uca* sp?) cited by J. K. Stanford (1951, Crab-eating Chital. *J. Bombay nat. Hist. Soc.* **50** : 398-9). It should not, therefore, be surprising if under force of circumstances, the goats of Barren Island, have modified their dietary habits to include crabs also on their menu!

Any light on the food habits of these goats, based on direct observation, will be very welcome.

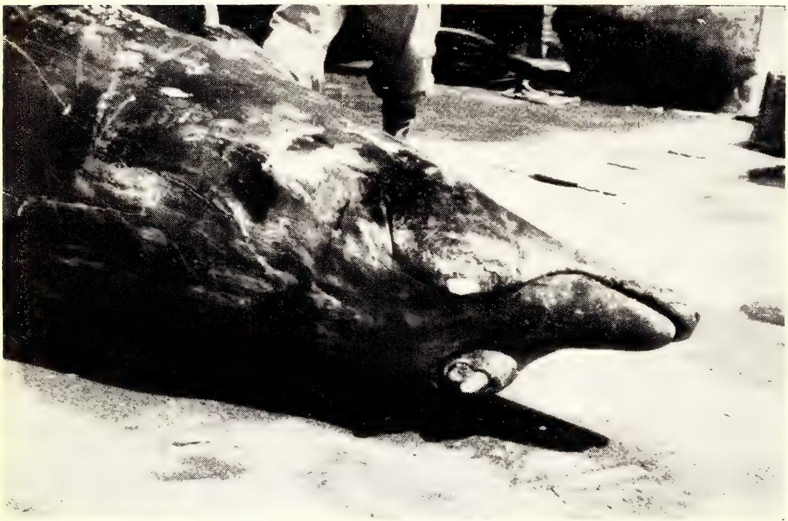
ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA 12,
March 15, 1963.

K. K. TIWARI

Mesoplodon densirostris (Blainville), adult male

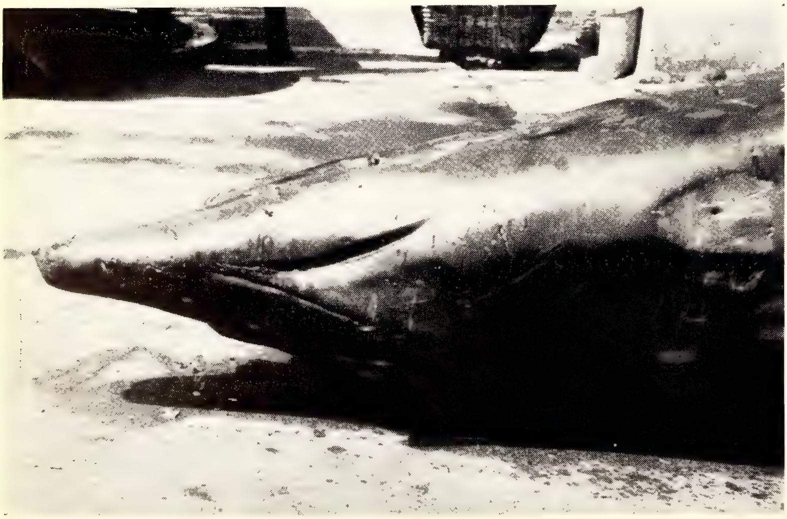


Whole animal, ventral view.



Dorsal view. Note the enormous dental eminences and teeth.

Photos :
Courtesy Yaichiro Ok



Ventral view. Note the V-shaped gular groove.

[B. B. Osmaston (1907, A Visit to Barren Island in the Andamans, *J. Bombay nat. Hist. Soc.* **18** : 357-9) recorded that goats on Barren Island drink salt water, and William Beebe (1947, BOOK OF BAYS) speaks of goats on Guadalupe Island that drink sea-water and eat kelp exposed at low tide. In this connection reference may also be made to Dr. Alain Bombard who, in his lone venture across the Atlantic, sustained life for two months on sea-water (not more than one and a half pints per day), plankton collected with a small net trailed behind his craft, and such fish as he caught from time to time (1956, Alain Bombard: THE BOMBARD STORY. Penguin Books).—EDS.]

5. OCCURRENCE OF BLAINVILLE'S BEAKED-WHALE [*MESOPLODON DENSIROSTRIS* (BLAINVILLE)] IN THE INDIAN OCEAN[1]

(*With one plate and two text-figures*)

Dr. Yaichiro Okada, Director of the Fisheries Research Laboratory, Tokai University, Shizuako, Japan, sent me some photographs of a beaked-whale for determination. The specimen had been caught about the middle of June 1963 in the Indian Ocean, in the vicinity of the Seychelle Islands, 5° S. × 65° E., by one of the Japanese Tuna fleets of the Faiyo Fishing Company operating in the Indian Ocean.

The photographs clearly indicated that the specimen was an example of an adult male Blainville's Beaked-Whale, *Mesoplodon densirostris* (Blainville), one of the least recorded members of the genus. Unfortunately, the specimen was cut up for food, but the photographs leave no doubt of its identity.

Mesoplodon densirostris is one of the rarer species of the genus *Mesoplodon*; only twelve or thirteen specimens have been recorded since it was first described in 1817, and that from a mere fragment of the rostrum measuring only 225 mm., without locality. This, the type, is in the Paris Museum. In addition, a skull obtained in the Seychelle Islands in 1839 is also in the same museum.

The majority of the known specimens have been recorded from the Atlantic coasts of North America, including Canada. One stranded in eastern Australian waters (Queensland) and another on Lord Howe Island. Three specimens have been recorded from South Africa.

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[1] The author is engaged on a revision of the genus *Mesoplodon*.

Blanford (1888-91 : 573) recorded no Ziphioids as definitely occurring wthin the limits of his FAUNA, but suggested the possible occurrence of *Ziphius cavirostris* Cuvier and *Mesoplodon densirostris* (Blainville) in India Seas. The former ranges very widely and has been caught or stranded in widely separated parts of the world, between the northern and southern tropics.

The Ziphiidae comprise a family of smaller whales, *Ziphius, Hyperoödon, Mesoplodon, Berardius,* and *Tasmacetus.* With the exception of *Tasmacetus,* the other four genera have one (*Ziphius, Hyperoödon,* and *Mesoplodon*) or two (*Berardius*) pairs of large mandibular teeth only, situated either at the extremity of the rami (one in each) or at some distance behind the tip, near or at the posterior union of the mandibular symphysis. With the exception of *Berardius,* the males alone erupt these mandibular teeth. The shape of the teeth is characteristic of the species. These functional teeth of the males are used as weapons of offence or defence in much the same manner as a boar uses its tusks. The males fight much among themselves and, at times, inflict severe linear scars on each other. In the females the corresponding teeth are present in the alveoli but are normally not erupted. Because of the close similarity in external form the females of *Mesoplodon* are sometimes difficult to determine correctly, when in the flesh.

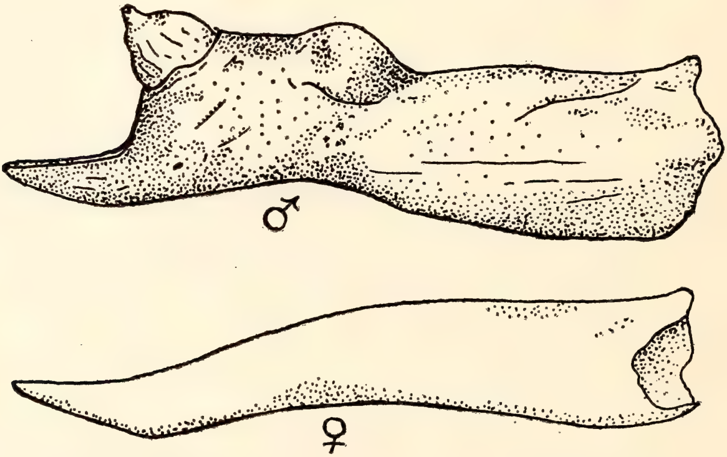

Fig. 1. Rami of *Mesoplodon densirostris* (Blainville)
Top : male ; bottom : female

In the genera *Ziphius, Hyperoödon,* and *Tasmacetus* the teeth are circular or ellipsoid in transverse section but in *Mesoplodon* and *Berardius* the teeth are strongly, laterally compressed. In *Tasmacetus* functional teeth are present in both jaws. Rudimentary teeth occasionally occur in some of the genera, but they are normally not socketed in alveoli.

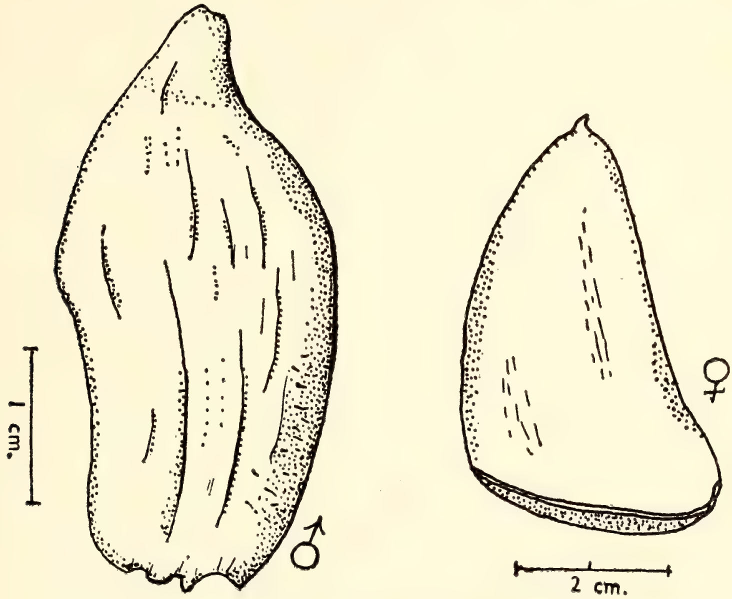

Fig. 2. Teeth of *Mesoplodon densirostris* (Blainville)
Left : male ; Right : female

The genus *Mesoplodon* comprises eight species not exceeding 6 metres (20 ft.). Some are confined to the Northern Hemisphere while others are restricted to the Southern Hemisphere, but occasionally one or the other of the species may be found a long way from its known territorial waters. Very little is known of the habits and movements of the various species. Of all the species *M. densirostris* appears to visit intertropical waters more frequently than do any of the others.

Blainville's Beaked-Whale. *Mesoplodon densirostris* (Blainv.)

Delphinus densirostris Blainville, 1817, Nouv. Dict. Hist. Nat., 2nd ed., **9** : 178. (Type loc. unknown.)

Mesoplodon densirostris Flower, 1872, *Trans. Zool. Soc. Lond.* **8** : 11.

Description. Head and body fusiform, deepest in the middle, strongly compressed caudally. Head moderate, not well defined by a nuchal depression; rostrum prominent, subacute, posteriorly concealed in lateral view between the dental eminences of the mandibles carrying the teeth; mandible slightly longer than the rostrum. Mandibular teeth in male large, attaining a vertical height of 150 mm., antero-posterior width 85 mm. and a lateral diameter of 44 mm., teeth obliquely ovate-lanceolate in shape, with furrows and striae on the lateral faces; obliquely set in the jaw with the apex directed forwards. In the female, teeth unerupted, somewhat ligulate in shape with a minute apical mucro or cusp; vertical height 54 mm., antero-posterior width 30 mm., at base; lateral diameter 7 mm. (There is no bony eminence for the tooth.) Blowhole crescentic, median. Eye moderately large. Two throat grooves present, forming an open V, following the angle of the diverging rami. Flippers moderate, subacute; flukes moderately large with no median notch; lobes slightly falcate. Dorsal fin nearer the caudal, well behind the centre of the body, triangular or slightly falcate.

Size. No specimen exceeding 4.4 metres (14 ft. 8 in.) has been recorded (male). *M. densirostris* appears to be the smallest member of the genus. Skull length reaching 770 mm. by 494 mm. at the widest.

Colour. Nearly completely black. Occasionally some lighter spots ventrally between the flippers and paler around the anal and genital openings. Undersurface lighter, greyish or whitish. In males the body is frequently covered with criss-cross 'battle scars' made by the teeth of the opponents. Such scars are linear and may vary from a few centimetres to over a metre in length. In addition, the body of both sexes often bears oval or elliptical scars scattered over the body, but particularly in the vicinity of the vent. These scars are often caused by parasitic and epizoic animals. However, it must be remembered that the colour of cetaceans alters very rapidly after stranding and the skin turns black.

ACKNOWLEDGEMENTS

I wish to express my thanks to Dr. Y. Okada for his kind permission to reproduce the photographs accompanying this article.

17, CLARKE STREET,
KHANDALLAH,
WELLINGTON N. 5,
NEW ZEALAND,
November 18, 1963.

CHARLES McCANN

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6. OCCURRENCE OF THE WHITERUMPED SWIFT [*APUS PACIFICUS* (LATHAM)] AT HINGOLGADH, JASDAN, GUJARAT

On 25 August 1963 while watching the small flock of House Swifts (*Apus affinis*) which are always wheeling about this ancient fort on a hill which is over a 1000 feet high and rises out conspicuously from the surrounding low hills and plain, I saw a single Whiterumped Swift. This bird wheeled about at great speed for a few minutes before disappearing again. I can trace no previous record of its occurrence in Gujarat.

THE PALACE,
JASDAN,
August 27, 1963.

YUVRAJ SHIVRAJKUMAR

7. OCCURRENCE OF THE LARGE WHITERUMPED SWIFT [*APUS PACIFICUS LEUCONYX* (BLYTH)] IN BOMBAY

On 11 November 1957, Bombay city was threatened by a storm which failed to show up, but two swifts *Apus pacificus* and *Apus affinis* were blown into houses facing the sea at Walkeshwar and Colaba respectively. The Regional Meteorological Centre stated that the storm initially formed as a depression in the south-east Arabian Sea and moved in a north-north-easterly direction. The birds were sent to Br. A. Navarro of St. Xavier's High School, who in his turn forwarded them to the Bombay Natural History Society for subspecific identification. Both the birds were new to Bombay and, owing to lack of suitable material here, were sent to the British Museum (Natural History) where Mr. J. C. Macdonald identified the former as *Apus pacificus leuconyx* (Blyth). Though Ripley (SYNOPSIS : 210) refers to the occurrence of this race 'south in winter to Bombay, Hyderabad, Kanara, Malabar (once) and possibly Madras', it may be worthwhile drawing attention to the fact that no one appears to have recorded it in peninsular India after Davidson (1898, *J. Bombay nat. Hist. Soc.* **12** : 47-48) who said 'this is the common Kanara swift . . . . it appears in large flocks occasionally at Karwar during the rains and all along the coast it may be found in the cold weather'.

With the recognition of *kanoi* (Yamashina) in 1942, we have no specimen from India or Burma in the Bombay collection which can be said to be typical *pacificus*, which according to Deignan (1956, *Bull. Raffles Museum* **27** : 147-148) has a white rump averaging 20 mm. in breadth. Perhaps, it may be worthwhile ascertaining if typical *pacificus* has a place in the Indian avifauna. Dr. Charles Vaurie in a letter dated 27 March 1962 very kindly gave me the following wing measurements which may be worth recording.

10 males of *leuconyx*: 155-171, avg. 158.5 mm.
10 males of *kanoi*: 176-188, avg. 181.6 mm.

The present specimen B.N.H.S. No. 20055 is a female with the wing measuring 158 mm. and the white of the rump 13 mm. broad. In spite of the name the claws are not white.

Mr. Macdonald was unable to identify the other swift racially, but I have had opportunity of comparing it with fresh material and a separate note on the races of *Apus affinis* is under preparation.

I must draw attention to the paucity of bird skins available for comparison and work in Bombay. While our collection is among the best in the country, it is not sufficiently representative and large gaps become apparent as soon as one attempts subspecific identification. Regional collections were made either by the Society or with its collaboration during the pre-war years, but the taxonomic work was carried out abroad and the type specimens and others of particular interest were retained by the workers or by the British Museum. I have no statistical information but have gained the impression that many of the key specimens referred to in relevant literature are not available here. The last word regarding the taxonomy of Indian birds has not yet been said and I hope it will be possible, with the assistance of members resident in different parts of the country, to build up a really representative collection within a reasonable time so that the racial differences, at least of the forms resident in India, can be satisfactorily studied and finalised here.

Messrs. Faiz & Co.,
75, Abdul Rehman Street, HUMAYUN ABDULALI
Bombay 3,
September 4, 1963.

[In the BOMBAY GAZETTEER, 1880, at page 97, *Cypsellus leuconyx* is included as a doubtful entry in Captain E. A. Butler's 'A catalogue of the birds of the southern portion of the Bombay Presidency'.—Eds.]

8. OCCURRENCE OF THE BLACKCAPPED KINGFISHER [*HALCYON PILEATA* (BODDAERT)] NEAR MADURAI, MADRAS STATE

Unfortunately the trees in and around the tank at Uthamapalayam were felled this year and the Blackcapped Kingfishers which were observed there in 1961 [vide my note in Vol. **59** (2) of the *Journal*, August 1961] appear to have left the place.

However I have further observations of this species to report:

(*a*) On 23 December 1962 I observed a single bird at a tank near the village of Yelangapatti not far from Madurai, Madras State.

(*b*) On 27 April 1963 I saw a pair in a deserted well-wooded creek on the upper reaches of the Periyar Lake, Kerala State. I could not ascertain if these birds were nesting in the area but as the place where I saw them is very secluded there is hope that they may become resident there.

Yelangapatti must be at least 80 miles from the nearest sea coast on the east and still further on the west, and Periyar Lake is approximately 60 miles from the Kerala coast line. The occurrence of these birds so far inland would seem to be very unusual.

Pambanar Estate,
Peermade P. O., M. C. A. JACKSON
Kerala State,
South India,
June 28, 1963.

[There are several records of the occurrence of the Blackcapped Kingfisher far inland. It has so far been recorded in south India from Coimbatore, Cumbum Valley (Madras State), and as nesting at Gersoppa (Mysore) and in Travancore.—Eds.]

9. RE-APPEARANCES OF THE HAIRCRESTED, OR SPANGLED, DRONGO [*DICRURUS HOTTENTOTTUS* (LINNAEUS)] IN KUTCH

I have been watching with great interest the more or less regular appearances of *Dicrurus hottentottus* (Linnaeus) in Kutch during the last few years. Since I collected the first bird on December 29, 1956 [*J. Bombay nat. Hist. Soc.* **55** (3) : 575] I have come across the Haircrested Drongo on 25 December 1958 and 30 January 1959, and in December 1961 and January 1962. I have toured the whole district off and on during the last four years but curiously enough I have not come across this bird anywhere except at Mandvi. While on a visit to Mandvi from 24 December 1962 to 7 January 1963 I once again saw my old friends. At first I saw only two birds on 24 December from the back verandah of Vijaya Vilas Palace, but later on when I went into the garden to have a closer look at them I saw one more bird and noticed that all the three more or less kept together. During the whole of my stay at Mandvi I heard them calling and saw them practically every day; but they were absent when I went there again in the middle of February.

Jubilee Ground,
Bhuj, Kutch,
October 20, 1963.

M. K. HIMMATSINHJI
Member of Parliament (*Lok Sabha*)

10. ANGRY BEHAVIOUR OF HOUSE CROW *CORVUS SPLENDENS* VIEILLOT

I work in an office in a street just off Sir Pherozeshah Mehta Road. A few days ago, when I was relaxing on the terrace, a house crow (*Corvus splendens* Vieillot) alighted on the parapet. The bird was very agitated, and was cawing loudly. The reason was evidently the feather that had been passed through its nostrils by some practical joker. For some minutes the crow fluttered up and down, trying to wipe off the feather against the edge of the expanding metal awning over my head. It then tried the metal supports of the awning, where two strips of metal came together, and soon managed to get the feather caught in the chink between them and so drew it out. It proceeded to make a determined attack on the feather. For some time, continuing its frenzied cawing, it worried the feather, trying repeatedly to push it back into the chink, dropping it and catching it as it fell—almost as if it wanted to punish the feather. At last an irate peon rushed out and drove away the crow, but its outraged voice was heard for a long while afterwards, from the tops of neighbouring buildings.

49, Pali Hill,
Bandra, Bombay 50,
August 9, 1963.

IRA REUBEN

11. OCCURRENCE OF THE BLACKHEADED CUCKOO-SHRIKE [*CORACINA MELANOPTERA* (RÜPPELL)] IN KUTCH

While out on my usual round of bird watching in the grounds of Vijaya Vilas Palace, Mandvi, on 4 April 1963, I came across a male Blackheaded Cuckoo-shrike [*Coracina melanoptera* (Rüppell)]. I observed him for quite some while in the *jamun*, mango, and other trees in the garden. During the period I watched him, he gave me the opportunity of studying his typical undulating flight more than once. I had seen this bird in the same place during the cold weather of 1962-63, but was able to catch a mere fleeting glimpse and hence a definite identification was not possible then. Unfortunately, I did not record the date, but it was seen during my stay at Mandvi between 24 December 1962 and 7 January 1963.

The Blackheaded Cuckoo-shrike is found in many places in India, including Gujarat, but according to R. S. Dharmakumarsinhji (BIRDS OF SAURASHTRA) it is uncommon in Saurashtra. In view of the fact that this bird has been neither seen nor mentioned by Dr. Sálim Ali, Capt. Lester, or any other ornithologist, my sight record can be considered a very rare occurrence of this bird in Kutch. It is easy to miss this bird owing to its habit of keeping absolutely silent and also because of its preference for remaining in the thick foliage of trees.

I might also mention here the Whitebrowed Fantail Flycatcher (*Rhipidura aureola* Lesson) which I saw at a village called Rav near Rapar on 3 February 1962. This bird also seems to be a very rare cold weather visitor to Kutch. Lester mentions it, but the Sálim Ali Survey did not meet with it and this was the first time I came across the bird in Kutch.

Jubilee Ground,
Bhuj, Kutch,
October 11, 1963.

M. K. HIMMATSINHJI
Member of Parliament (*Lok Sabha*)

12. RECOVERY OF RINGED BIRDS

Ring No.	Species	Date of Ringing	Place of Ringing	Recovered on	c covery	Remarks
A—992	*Emberiza melanocephala*	26.9.1959*	Changalra, Bhuj, Kutch (*c.* 23° 18′ N., 69° 43′ E.)	Found dead, 26.5.1961	Temizkhbekshaia, Kavkazskaia Dist., Krasnodar (*c.* 45° 30′ N., 40° 45′ E.), *c.* 3730 km. NW. of Kutch	Reported by the Bird-Ringing Bureau, USSR Academy of Sciences, Commission for Nature Protection, Moscow, USSR
A—4777	*Motacilla alba*	16.3.1961*	Asambia Kutch (*c.* 22° 51′ N., 69° 32′ E.)	Found sick or wounded and perished, 11.7.1961	Zimnyatsky Dist., Volgograd Region (=Stalingrad), *c.* 38 km. SSW. of Mikhailovka (*c.* 49° 35′ N., 43° 07′ E.), *c.* 3660 km. NW. of Kutch	do.
A—19082	*Motacilla flava thunbergi*	19.12.1962*	Edanad, Chengannur, Kerala (*c.* 9° 20′ N., 76° 38′ E.)	Shot by man, 8.9.1963	14 km. south of Kara-Balty, Kirghiz SSR. (*c.* 42° 50′ N., 73° 50′ E.), *c.* 3700 km. north of Edanad	do.
C—382	*Anas querquedula*	4.4.1962*	Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.)	Shot by man, 15/18.8.1962	Chernobyl Dist., Kiev Region (*c.* 51° 19′ N., 30° 14′ E.), *c.* 4760 km. NW. of Bharatpur	do.

* These were ringed in the course of BNHS/WHO Bird Migration Field Project.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6-WB,
November 27, 1963.

EDITORS

13. SECOND RECORD IN INDIA OF THE GECKO *GEHYRA MUTILATA* (PEROPUS)

During a tour to Kottayam, Kerala, in May 1963, Mr. S. R. Sane of Messrs Sachetan, Bombay, collected and presented a few specimens of Geckos to the Society, which were later identified as *Gehyra mutilata* (Peropus).

Though very widely distributed in the Oriental and Australian regions, there is only a single record of its occurrence in India (Cochin, Kerala) [Smith, F. B. I. Rep. & Amph. **2** : 106]. According to Mr. Sane the gecko is very common on trees in gardens along with *Hemidactylus frenatus* and is nocturnal in habit. The species is known to be transported in cargoes which may explain its occurrence in Cochin. The present record further south indicates that it has now established itself in south-west India.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6-WB,
October 16, 1963.

P. W. SOMAN
Research Assistant

14. A LIST OF THE REPTILES AND AMPHIBIANS OF THE SURAT DANGS, SOUTH GUJARAT

The Surat Dangs area of south Gujarat where the Western Ghats dovetail with the Satpura range of hills is of considerable interest faunistically being the northernmost limit in the range of many species, for instance of birds (Ali, Sálim 1954)[1] previously believed to be restricted to the more humid regions of the southern ranges of the Western Ghats. The collections reported here are not extensive, made as they were when opportunities offered, by one of us (E. M. S.) during several years' stay at Ahwa, the Dangs District Headquarters, and together in July 1963 when J. C. D. visited the Dangs for a short period. The list can be considered only as a preliminary survey and we are confident that many species, now considered to be confined to the southern areas of the Western Ghats, would be recorded from the Dangs if an extensive survey were made of the herpetology of the area. Distributional records are mentioned only for species whose occurrence in the Dangs is an extension of the known range in the case of amphibia and for reptiles, as given by Smith in the FAUNA OF BRITISH INDIA, Reptilia and Amphibia **1**, **2** and **3**.

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[1] Ali, Sálim (1954) : The Birds of Gujarat. Pt. I. *J. Bombay nat. Hist. Soc.* **52** ; 374-458.

REPTILIA

Family CROCODILIDAE

1. **Crocodilus palustris** Lesson 1834

The Marsh Crocodile has been recorded at Mahal, Waghai, and Mulchond. The largest, approximately 10 to 12 ft. in length, was seen at Waghai. In March 1954 a small specimen about 1½ to 2 ft. in length was seen on the road near Mulchond but escaped capture by running into the grass by the side of the road. The nearest pool of water was about a furlong away. Formerly the *mugger* was quite common in the Dangs but in the past ten years or so it has become uncommon.

Family EMYDIDAE

2. **Geomyda trijuga** Schweigger 1814

Uncommon. A female collected on a road at night on 11 August, 1956 contained several oval hard-shelled eggs, and was perhaps in search of a suitable site to lay.

Family GEKKONIDAE

3. **Hemidactylus maculatus** Dum. & Bibr. 1836

Two specimens, one collected from the wall of an outhouse in 1958 and another inside the hollow of a tree at Ahwa in 1963. Near Bombay the species is most often seen on rocks and in rock-cut caves. The recorded distribution is Bombay District, Malabar, Salem, and Tinnevelly in south India. Anderson (1871)[1] records a specimen from Berar in the collection of the Indian Museum but this has not been included either by Boulenger or Smith in their volumes of the FAUNA.

4. **Hemidactylus brooki** Gray 1845

Common under stones and on trees. Those seen on stones in stream beds were invariably blackish.

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[1] Anderson, John (1871): On some Indian reptiles. *Proc. Zool. Soc. London*: 149-211.

5. **Hemidactylus leschenaulti** Dum. & Bibr. 1836

Common, one or two always on the wall near the mercury vapour lamp at the Ahwa Bus Depot, feeding on the enormous number of insects, mostly moths, attracted by the light. The geckos keep to the darker face of the wall away from the light.

6. **Hemidactylus flaviviridis** Rüppell 1835

One specimen taken off a trellis overgrown with jasmine vine in the mission compound.

Family AGAMIDAE

7. **Calotes versicolor** (Daudin) 1802

Common. We noticed one specimen fast asleep, clinging to the wire mesh on a window adjoining the mercury vapour lamp at the Bus Depot at Ahwa oblivious of the insect food fluttering around. A clutch of 15 eggs found buried in loose soil in the Mission Garden in July 1955 began hatching on 7 September 1955. One of us (E. M. S.) has observed this species eating unripe pods with soft seeds of the *Lima* bean.

8. **Sitana ponticeriana** Cuvier 1844

One specimen at Waghai, the brown of the back was almost golden.

Family CHAMAELEONIDAE

9. **Chamaeleon zeylanicus** Laurenti 1768

Fairly common.

Family SCINCIDAE

10. **Mabuya carinata** (Schneider) 1801

Common.

11. **Riopa guentheri** (Peters) 1879

The extension of the range of this species to the Dangs has been already reported (J. C. Daniel, 1962)[1].

Family TYPHLOPIDAE

12. **Typhlops braminus** (Daudin) 1803

Common, often seen under logs and stones. Two were collected from a compost pit probably attracted by insect larvae and imagos.

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[1] Daniel, J.C. (1962) : Extension of range of the skink *Riopa guentheri* (Gray). *J. Bombay nat. Hist. Soc.* 59(3) : 965.

Family Boidae

13. **Eryx conicus** (Schneider) 1801

Fairly common, often mistaken for Russell's Viper.

14. **Eryx johni** Russel 1801

Common.

15. **Python molurus** (Linnaeus) 1758

Not uncommon. A 10 ft. long specimen was shot at Mulchond in 1959. An 8½ ft. long female collected in June 1954 at Ahwa contained sixty eggs.

Family Colubridae

16. **Ptyas mucosus** (Linnaeus) 1758

Common.

17. **Oligodon arnensis** (Shaw) 1802

One specimen. The scalation and markings agree with Smith's data for specimens from India south of lat. 20° N.

18. **Ahaetulla tristis** (Daudin) 1803

One specimen; not uncommon.

19. **Sibynophis subpunctatus** (Dum. & Bibr.) 1854

One specimen collected at Mulchond, 5 miles from Ahwa. The species is believed to occur north of lat. 18° and has been recorded in the Nasik District of Maharashtra adjoining the Dangs. There appears to be confusion in collection records between this species and *S. sagittarius*.

20. **Natrix piscator** (Schneider) 1799

Common, especially during and after the monsoon.

21. **Natrix stolata** (Linnaeus) 1758

Common.

22. **Macropisthodon plumbicolor** (Cantor) 1839

Common. The habit of erecting the forebody and flattening the head like a cobra was noticed in one specimen.

23. **Boiga trigonata** (Schneider) 1802

One specimen, on a jasmine vine in the Mission compound.

24. **Boiga forsteni** (Dum. & Bibr.) 1854

A correction is necessary to the earlier report on this species where it was recorded that the specimen collected by McCann at Mt. Abu was not reported earlier (Daniel 1962)[1]. McCann recorded this specimen in the *Journal* **43** : 645 (1946). The specimen from Ahwa was collected while it was trying to swallow a juvenile myna.

25. **Dryophis nasutus** Lacépède 1802

Fairly common.

Family ELAPIDAE

26. **Bungarus caeruleus** (Schneider) 1801

Fairly common.

27. **Naja naja** (Linnaeus) 1758

Fairly common.

Family VIPERIDAE

28. **Vipera russelli** (Shaw) 1797

Common. Every year during the grass-cutting season after the monsoon a few are seen and killed.

29. **Echis carinatus** (Schneider) 1801

Fairly common.

30. **Trimeresurus gramineus** (Shaw) 1802

Fairly common at Ahwa, usually seen on hedges. A Rhode Island Red cock bitten by one died in about 20 minutes.

AMPHIBIA

The amphibians unless otherwise mentioned were collected in the last week of July 1963.

Family BUFONIDAE

31. **Bufo melanostictus** Schneider 1801

Specimens collected: Ahwa 1 ♂, 2 juv.; Waghai 1 juv.

The male has the throat yellow but the nuptial pads on the fingers are peeling. Of the juveniles the two collected at Ahwa (22 mm., 25 mm.) appear to be of an earlier brood and the Waghai specimen

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[1] Daniel, J.C. (1962) : Extension of the known range of the Catsnake, *Boiga forsteni* (Dum. & Bibr.). *J. Bombay nat. Hist. Soc.* **59**(3) : 966-7.

(10 mm.) of the current season. Breeding was over in July. No tadpoles were seen nor was any breeding activity noticed among the adults. The call was not heard. Several were seen below lights feeding on insects.

Family MICROHYLIDAE

32. **Microhyla ornata** (Dum. & Bibr.) 1841

Common. The male was heard calling and four were located in grass with some difficulty. Average size 23 mm. A shoal of tadpoles were seen in a rainwater pool overgrown with grass.

33. **Uperodon globulosum** (Günther) 1864

Specimens collected: Ahwa 1 ♂, 1 ♀ July; 1 ♂, 1 juv. August 1963.

A male was located by its distinctive call in a small cement cistern on the evening of 30 July. When sighted it dived into the water and in searching we missed the male but collected a female. The male was caught later in the night by E. M. S., when it resumed calling. The call was not heard before the 30th but was heard on subsequent days at Ahwa and at Waghai. The breeding season is apparently later in the Dangs than in Bombay (June). Tadpoles were not seen. The species has not been recorded north of Bombay on the west coast.

34. **Ramanella montana** (Jerdon) 1854

Specimens collected: Ahwa 1 ♂, June 1963.

A specimen was collected in June while calling from a small cavity containing water on a mango tree. Its occurrence at Ahwa marks the northernmost range of its distribution. The species has so far been reported from Bombay to Trivandrum in the coastal and hill areas.

Family RANIDAE

35. **Rana cyanophlyctis** Schneider 1799

Very common, calling at Ahwa and Waghai. In this species however the calling is not restricted to the breeding season. One specimen was rufescent brown in colour.

36. **Rana limnocharis** Boie 1835

Common. Three males were collected from a dry nullah after a shower of rain. The smallest breeding male measured 28 mm. and had a broad light-coloured band on the back. The specimens collected resemble the var. *syhadrensis* of Annandale.

37. **Rana tigrina** Daudin 1803

Common. A juvenile collected has three yellowish green lines on the body, one median and two lateral from behind the eye to the groin with a branch to the shoulder. Adults seen were not breeding.

38. **Rana breviceps** Schneider 1799

A male (45 mm.) was collected while calling. The call is a soft *awang* which can be heard at considerable distances. The tibio-tarsal articulation lacks the tubercle noticed in some south Indian specimens. Though robust they are not toad-like as are specimens from the south (Trivandrum), resembling in this character specimens from Bombay. Tadpoles were collected from a hill-stream as well as just metamorphosed young which measure *c*. 10 mm.

39. **Rana leithii** Boulenger 1888

Several tadpoles were collected at a hill-stream off rocks wetted by spray. Very active and the coloration so well matches the dark grey of the rocks that it is very difficult to distinguish them. The recorded distribution of the species is from Panchgani to Bombay.

Family RHACOPHORIDAE

40. **Rhacophorus leucomystax maculatus** Gray 1832

Common, heard at night on trees surrounding a small rainwater pool.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
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J. C. DANIEL
Curator

CHURCH OF THE BRETHREN MISSION,
AHWA, VIA BILLIMORA,
DANGS DISTRICT, GUJARAT STATE,

E. M. SHULL

November 27, 1963.

15. OCCURRENCE OF THE FUNGOID FROG *RANA MALABARICA* (BIBR.) AT JAGDALPUR, BASTAR DISTRICT, M. P.

Recently one of us (T. G. S.) collected a frog at Jagdalpur, Bastar District, M. P., which was later identified as the Fungoid Frog [*Rana malabarica* (Bibr.)]. The species is not uncommon in the Bastar area of Madhya Pradesh. *Rana malabarica* has so far been reported only from the Western Ghats from Kasara Ghat near Igatpuri (Abdulali *in* V. K. Chari, 1962) to central Kerala where specimens have recently been collected by P. B. Shekar of the Society's staff at Edanad, Alleppey District. The species has also been reported from the Nilgiri Hills.

Instances are available of bird species with Indo-Malayan affinities, occurring only in the Western Ghats in peninsular India, being reported from Bastar (Ali, Sálim 1951). The Satpura trend of hills have been postulated as the route of migration of these elements of the Indo-Malayan fauna to the Western Ghats. However, the affinities of *Rana malabarica* which is endemic are with the African fauna where there exists a very closely allied species. It is likely that the species may occur in suitable biotopes in other areas of peninsular India.

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T. G. SELUKAR
Lecturer in Zoology

October 20, 1963.

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16. OCCURRENCE OF THE CEYLON KALOULA, *KALOULA PULCHRA TAPROBANICA* H. W. PARKER (FAMILY MICROHYLIDAE) AT JAGDALPUR, BASTAR DISTRICT, M.P.

In October 1963 one of us (K. K. V.) collected a specimen of *Kaloula pulchra taprobanica* H. W. Parker in the compound of his residence at Jagdalpur, Bastar, M.P. Parker (1934) in A MONOGRAPH OF THE FROGS OF THE FAMILY MICROHYLIDAE: 87, gives the range of this species as 'India South of the Ganges' though specimens were seen by him only from Cauvery River, Madras, and Calcutta. Recently Abdulali (1962) reported the species from Dandeli in North Kanara, Mysore. The genus *Kaloula* is Indo-Malayan and is represented in India solely by this species and its occurrence in Bastar is significant in view of several other Indo-Malayan forms previously recorded from the area (S. L. Hora 1949; Sálim Ali 1951).

It is interesting to note that the distributional records of another genus of Amphibia *Philautus* with Indo-Malayan affinity also relates to the Western Ghats, Eastern Ghats, and eastern India. One species *P. variabilis* has been reported from the Western Ghats and from Golconda in the Eastern Ghats. Recently one of the Society's staff, P. B. Shekar, collected this species in the Shevaroy Hills also. Hora (1949) and Abdulali (1949) have suggested the Eastern Ghats as an alternative route to the Satpura trend of hills for migration of terrestrial Indo-Malayan species to Western India which these records seemingly substantiate. However, it must be noted that the Amphibian fauna of the Satpura Hills is more or less unknown.

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November 1, 1963.

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17. OCCURRENCE OF THE BUTTERFLIES *NEPTIS HORDONIA HORDONIA* STOLL, AND *ISSORIA SINHA PALLIDA* EVANS IN MUSSOORIE : NEW ALTITUDE RECORDS

In the *J. Bombay nat. Hist. Soc.* (Vol. **11**, 1898) Mackinnon & de Nicéville published a 'List of the Butterflies from Mussoorie and the Dun Valley'. Since the publication of this list Brigadier W. H. Evans (1932), Lt.-Col. H. D. Peile (1937), and Mr. M. A. Wynter-Blyth (1957) have added a number of species to this area. As there is a great deal of difference in the altitude of Dehra Dun (2300 ft.) and that of Mussoorie (3000 to 8000 ft.) some species recorded in Dehra Dun are not found in Mussoorie and vice versa.

During nine years of collecting butterflies in Mussoorie (largely confined to the months of May and June and rarely in October), the writer has collected only two species which represent a considerable change in altitude. These two are of the family Nymphalidae and are as follows:

Neptis hordonia hordonia Stoll : The Common Lascar

Mackinnon & de Nicéville found this species in the Dun only (never in Mussoorie) during April, May, September, and October.

Evans gives its range as: 'S. India; Dun—Burma' (p. 172).

Peile records its range as: 'S. India; Dun to Dawnas' (p. 131).

Wynter-Blyth gives its range as: 'S. India; Dehra Dun to Assam and Burma', and limits its altitude 'to 7000 feet in the hills of the south; to about 2500 feet in the north' (p. 197).

On 20th May 1963 the writer caught a perfect Common Lascar at the famous Pumping Station (alt. 5600 ft.) in Mussoorie. As Mussoorie is situated in the north-west Himalayas this record constitutes an altitudinal range extension in the north of 3300 ft.

Issoria sinha pallida Evans : The Vagrant

Mackinnon & de Nicéville refer to this species as *Vagrans egista* (*sinha*) and report it as rare in the Dun in August and December. (See Peile's *Appendix B*, p. 228.)

Evans gives its range as: 'Dun-Kumaon' (p. 187).

Wynter-Blyth gives its range as: 'Dehra Dun to Sikkim, Bengal, Orissa, Assam and Burma' (p. 226). He states further that it is found 'at low or moderate elevations in the hills . . .' (p. 226).

The writer has collected several Vagrants at much higher elevations, as follows:

25th May 1963: one in the Kolti Valley (alt. 3500 ft.) near Mussoorie;

3rd June 1963: three at the Pumping Station (alt. 5600 ft.) in Mussoorie;

4th June 1963: one more in the Kolti Valley;

12th June 1963: five at Kempti Falls (alt. 4500 ft.) in Mussoorie.

The above records considerably extend the altitudinal ranges of the Common Lascar and the Vagrant in the north-west Himalayas.

DANGS RURAL BOARDING SCHOOL,
CHURCH OF THE BRETHREN MISSION,
AHWA, VIA BILLIMORA,
DANGS DIST., GUJARAT STATE,
September 20, 1963.

ERNEST M. SHULL

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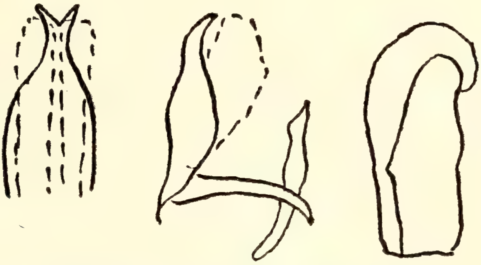
18. BUTTERFLIES : HESPERIIDAE : *POLYTREMIS MINUTA* EVANS

(*With a text-figure*)

Figured in colour in Evans's CATALOGUE OF THE HESPERIIDAE OF EUROPE, ASIA AND AUSTRALIA 1947 with genitalia on his Plate 53. But his drawing is that of a broken clasp. The figures below are correct, taken from a male captured at Pathechaung, Karens, in December 1926 and found by me in a tin of the Tytler collection in the British Museum (Nat. Hist.) and dissected because I was unable to identify it by facies. In front of the uncus are two non-chitinous membraneous processes, transparent in liquid (I dissected by the wet method) but opaque when dry (Evans dissected by the dry method). Being flexible in liquid, they can be partially unrolled from the interior edges. They are shown in outline by me by discontinuous streaks to indicate transparency. No such processes are found in any other Hesperiid. This is a worn DSF; two of the normal 3 apical spots are missing as also the discal spot in 4 and there are no spots UPH or UNH and no ochreous-green scales UNH. But it has two cell spots UPF; a surprising character as the others have only a lower spot. Only 3 males and 2 females are in the British Museum.



Genitalia of *Polytremis minuta* Evans

5, Upper Wimpole Street,
London, W. 1,
July 25, 1963.

KEITH CANTLIE, C.I.E.

19. USE OF VERTEBRATE FAECES BY THE SPHECOID WASP *CHALYBION BENGALENSE* DAHLB.

Chalybion bengalense Dahlb. [*Sceliphron violaceum* (Fabr.)] (FAUNA OF BRITISH INDIA, Hymenoptera **1** : 240) is a metallic bluish-black, so-called domestic, wasp which puts several spiders, to one of which an egg is attached, into pre-existing holes or cavities, which she then seals. The finished lid to the cell, in the majority of cells we have seen, is white. Maxwell-Lefroy (1909)[1] states that these wasps use lime or plaster to seal such holes.

However, we have observed that these wasps, having provisioned their cells, first make a lid of mud (in this part of India, reddish brown to brown). Having made this lid which requires several loads, they then proceed to coat it with a white substance which is carried in the mouth, as mud is brought. The first load is spread all over the red mud which thus becomes pinkish. A further load, or loads, completely obliterates any underlying colour. On three occasions, wasps so covered the red mud lids which had been built and left as finished by wasps of the Vespoid species *Antodynerus flavescens,* which nests in similar holes. Therefore the covering with white is an act independently stimulated by a mud lid, not part of an inevitable sequence of actions. We have observed one *C. bengalense* collecting this white substance from the faeces of our pet tortoises (*Testudo elegans*). Another individual used bird faeces. This is probably what they usually employ for this purpose.

Having made this smooth white concave or flat lid to the cell, the wasps sometimes go on to put several loads of a black substance on it, though this may be delayed and the black put on several lids at the same time. This does not usually cover completely the white, as the white covers the mud, but is put in the centre of the lid leaving an annular white margin. We have seen one wasp collecting this black substance, partly from the black portion of the tortoise faeces and partly from the encrustation on the cement lining of a drain. In another example, we did not see the wasp working, but only two finished cells. The topmost layers here looked crystalline, and consisted of many fragments of insect cuticle (among which head capsules were conspicuous) stuck on to the white. These may, of course, be from the faeces of any insectivorous reptile, bird, or mammal, but after inspecting the faeces of a *chuchunder* (*Suncus murinus*), we have little doubt that this is what was used. These shrews are very common in the yard from which the wasps collected material.

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[1] Maxwell-Lefroy, H. (1909): Indian Insect Life. Agricultural Research Institute, Pusa.

It is not clear under what stimuli these wasps do, or do not, blacken a lid, but all the above cells were in a disused wooden fitment in a not very well-illuminated bath-room.

This faeces-using habit makes *C. bengalense* a possible vector for diseases of those insectivorous vertebrates which prey upon them.

GENETICS AND BIOMETRY LABORATORY,
GOVERNMENT OF ORISSA,
BHUBANESWAR 3,
October 1, 1963.

S. D. JAYAKAR
H. SPURWAY

20. THE INDIAN HIVE BEE *APIS INDICA* FABR. (HYMENOPTERA) AND *SAPINDUS EMARGINATUS* VAHL WITH A NOTE ON *ACARAPIS WOODI* (RENNIE) (ACARINA)[1]

Storey (1890) reported that honey bees (*Apis indica* Fabr.) were attracted by the blossoms of *Lapindus emarginatus* (=*Sapindus emarginatus* Vahl?) and after drinking the nectar died in large numbers at Oodeypore. This has not been queried by any subsequent observer. It is therefore of interest to mention that honey bees do gather honey from this tree, and that a sample of such honey was exhibited by the Entomology Division of the Andhra Pradesh Agricultural Department at the World Agricultural Fair, New Delhi.

The latter part of the observation made by the author is also of interest, namely: 'the effect produced appears to be that of a powerful purgative and there are now numbers of bees buzzing about on the ground unable to fly'. The symptoms described are like those produced by the scutacarid mite, *Acarapis woodi* (Rennie).

Baker *et al.* (1952) state that *Acarapis woodi* (Rennie) is the cause of 'Isle of Wight' disease found in Europe. The mites harbour in the tracheal tubes and cause the death of the host, death being due to: (1) the parasite living upon the host fluids and causing active injury, or (2) possibly, toxic secretion, or (3) mechanical stoppage of the tracheae which prevents air from reaching the individual organs or cuts off the air supply to the nerve centres that control the bee's activities. Recently, Singh (1957) recorded this disease in India in Kulu and Kangra valleys and Simla Hills. He observes that a number of parasitised bees come out of the hive on a warm day, particularly after a cold and rainy spell and fail to return to the hive, as they are unable to fly and merely hop about. They crawl up blades of grass and form small groups. The front and hind wings get unhooked and have a 'K' wing appearance. The abdomen gets distended. The inside and outside of the hive and the ground in front of its entrance are plastered with yellow faeces indicating dysentery. The mites harbour in the anterior thoracic tracheae, which appear either bronzed or brown. He says that it has still to be ascertained whether the disease is already widespread in distribution and has assumed an endemic status or is only a recent introduction in this country.

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[1] Communicated by Dr. K. K. Tiwari, Zoological Survey of India, Calcutta.

I was recently in charge of examining the several hundreds of randomised samples of honey bees from different districts of Andhra Pradesh to find out the incidence of this disease in that State. Different methods of dissection were tried, but the one described below was found to be the most useful. A microscalpel is made out of a triangularly-cut edge of a new razor blade, fixed in a match-stick or discarded camel-hair brush. The specimen is decapitated a little below the neck. Another cut is made a little above the petiole and the sectioned thoracic part is transferred to a clean cavity block containing sterilised water. The contents of the thorax, i.e. muscles, gut, etc., are removed with the help of a fine forceps (watch repairer's NN and BB were used) under a stereoscopic microscope. This leaves the body wall with the tracheal tubes *in situ* for examination. With a little practice the method will be found quite comfortable. No instance of the mite was found.

My thanks are due to Dr. Md. Qadiruddin Khan and Shri C. Krishnamoorthy, the successive Entomologists of the Government of Andhra Pradesh, and Shri P. V. Ranga Rao, Assistant Entomologist, Regional Research Unit, Bapatla, for facilities and encouragement, and to the Director, Botanical Survey of India, Calcutta, for necessary information on the nomenclature of the host plant.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA 12,
May 6, 1963.

K. V. LAKSHMINARAYANA

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21. *LENSIA GNANAMUTHUI,*[1] A NEW SIPHONOPHORE FROM THE MADRAS PLANKTON

(*With a text-figure*)

Material

2 anterior nectophores from an open haul from 0 to 25 metres off the Madras coast on 26.9.1952.

4 anterior nectophores from surface plankton off the Madras coast on 4.12.1952.

2 anterior nectophores from surface plankton off Madras coast on 8.1.1960.

Diagnosis

Anterior nectophore small, 3.8 mm. in length and 1.8 mm. in breadth; 5 distinct non-crested complete ridges; somatocyst placed near the mouth of the nectosac, characteristically minute with a stalk and a minute globular tip. Hydroecium in level with the velum.

Size

Anterior nectophore: length 3.8 mm., breadth 1.8 mm.

Somatocyst: length 0.32 mm.

Description

Anterior nectophore very small, pyramidal in shape with five complete non-crested longitudinal ridges extending from apex to base; ventrobasal margin or corner slightly rounded. Hydroecium shallow, level with mouth of nectosac. Mouth plates large and divided. Somatocyst characteristically very small and situated on the summit of the hydroecium very near base of nectosac; with thread-like, minute, curved stalk (0.2 mm. in length) and a globular tip (0.1 mm. in diameter).

Stem and posterior nectophore not collected.

Type Material

The holotype and paratypes will be deposited in the collections of the Zoological Survey of India, Calcutta. An anterior nectophore collected on 26.9.1952 from 0 to 25 metres off the Madras coast has been designated as the holotype. 2 anterior nectophores from surface plankton of the Madras coast collected on 8 January 1960 have been designated as paratypes.

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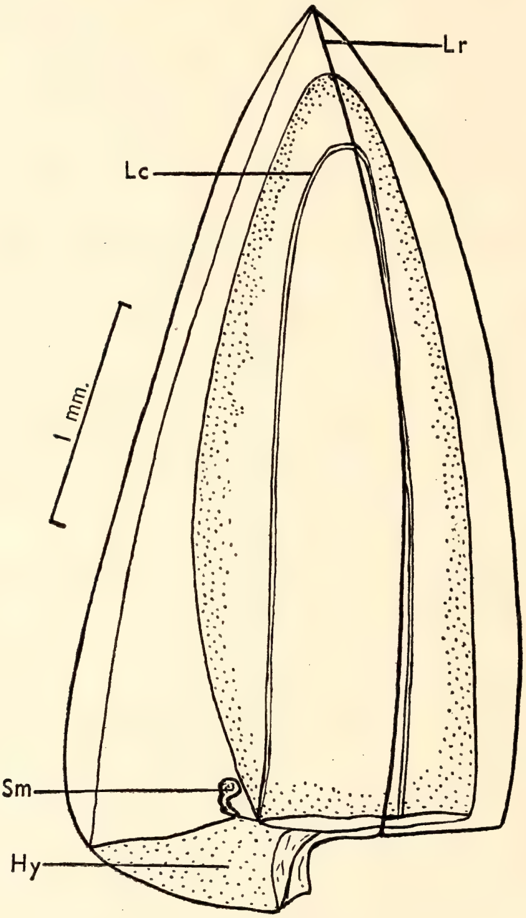
[1] Named after Prof. C. P. Gnanamuthu, Director, Zoological Research Laboratory, Madras.

Comparison

The genus *Lensia*[1] includes the following twenty-two valid species: *grimaldii*[2], *exeter*[3], *ajax*, *hostile*, *lelouveteau*, *meteori*[4], *reticulata*[5], *subtilis*[6], *cossack*, *multicristata*[7], *hunter*, *havock*, *subtiloides*[8], *conoidea*, *fowleri*[9], *campanella*, *achilles*, *hardy*, *hotspur*, *challengeri*, *leloupi*, and *tottoni*[10]. The present species differs from all the other species hitherto described in the minute size of the somatocyst, its position near the mouth of the nectosac, and its shape, and in the rounded margin of the ventral corner of the nectophore.



Lensia gnanamuthui sp. nov.

Lc—Lateral canal; Lr—Lateral ridge; Sm—Somatocyst; Hy—Hydroecium

Notes on Siphonophores: The Siphonophora includes 150 valid species of which 80 are known to occur in the Indian Ocean. We have recorded 29 species in the limited area of the Madras coast (Daniel & Daniel, 1963*b*).

The Siphonophores are wholly holoplanktonic agreeing well in their distribution with the holoplanktonic surface medusae. A great majority are epiplanktonic. During our studies on the Siphonophore fauna of the Madras coast during 1952-54 and 1956-60, 23 species were taken from surface plankton hauls. As typical examples of epiplanktonic forms *Diphyes truncata, D. monoica,* and *D. dispar* may be mentioned. Among Physophorae, *Agalma okeni* and *Anthophysa* are surface forms. *Velella, Porpita,* and *Physalia* in the adult stage are known from the surface only, though the larvae are sometimes seen in the lower regions also. No Siphonophore has adopted the ocean floor as its usual habitat and none are parasitic.

Although Siphonophores are known to occur in a wide range of temperature, they are absent (or at least uncommon) in regions of low salinity. None has penetrated into brackish or fresh water, and they are uncommon in Ocean regions of low salinity. In the Madras coast where the salinity varied from $30°/_{oo}$ to $35°/_{oo}$ during our studies the Siphonophores were found in abundance in the plankton hauls throughout the year, whereas in the adjoining brackish waters at the mouths of the rivers Adyar and Cooum they were not collected.

Siphonophores are very delicate animals and usually during collection and transferring, the different parts of the colony become detached. In the case of Diphyids the anterior and posterior nectophores are easily detached and as such, in the genus *Lensia* except for a few forms the posterior nectophores have not yet been matched or described.

This work was done in the Zoological Research Laboratory, University of Madras. We are grateful to Prof. C. P. Gnanamuthu, Director of the Laboratory, for his helpful suggestions.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM,
CALCUTTA, 13,
April 11, 1963.

A. DANIEL
(MRS.) R. DANIEL

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22. ON THE DISTRIBUTION OF *GYMNOSPORIA BAILADILLANA* NARAYAN & MOONEY

Kapoor & Srivastava in *J. Bombay nat. Hist. Soc.* **59** (2) : 685-686, 1962, have reported *Gymnosporia bailadillana* Narayan. & Mooney from Mahendragiri Hills of Orissa, extending its range of distribution eastwards to 18° 58′ N. × 84° 26′ E. The plant was originally collected by Mooney from Bailadilla Hill (Bastar State) between 1000-1200 m. Later on Mooney reported it also from Karlapet (Kalahandi State).

The authors seem to have overlooked a paper by R. Seshagiri Rao on 'Observations on the Vegetation of the Rampa and Gudem Agency Tracts of the Eastern Ghats' published in *J. Bombay nat. Hist. Soc.* **55** (3) : 429-449, 1958. *Gymnosporia bailadillana* Narayan. & Mooney, therein, is already reported as a new record for the N. Circars of Andhra Pradesh. Rao mentions it as one of the common shrubs near the deserted village of Nilavaram and the Ebul Reserve Forest in the Gudem Agency at about 1800 m.

The present authors have also collected the plant from Sankarimetta at about 900 m. in the Vizag Agency on 11 May 1956 with dehisced carpels. (The specimens *Santapau* 20551 and *Wagh* 2562, 2563 are preserved in the Blatter Herbarium, Bombay.) This extends the range of distribution still southwards, i.e. up to 18° 30′ N. and 82° 27′ E.

BOTANICAL SURVEY OF INDIA,
CALCUTTA 13,
October 19, 1963.

H. SANTAPAU, S.J., F.N.I.
S. K. WAGH, Ph.D.

23. DESCRIPTION OF *TEPHROSIA COLLINA* SP. NOV. AND TWO NEW VARIETIES[1]

(*With a plate*)

The author, while investigating the flora of Ajmer (Rajasthan), came across an interesting, hitherto unknown species of *Tephrosia*, together with a variety of the same. Both are being described in the present communication.

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[1] Communicated by the Director, National Botanic Gardens, Lucknow.

Tephrosia collina sp. nov.

Affinis nulli speciei indicae generis *Tephrosiae,* haec species distinguitur habitu simplici vel paulum ramoso, foliis paucioribus, racemis terminalibus vel oppositifoliis, laxis, elongatisque; corolla cremea et praesertim legumine longo, 8-11-sporo, marginibus valde crassis ornato.

Herba annua, erecta, 30-60 cm. alta. *Caulis* simplex vel paulum ramosus, rarius suffrutescens, teres et tenuiter pubescens ad basin, supra vero angularis vel nonnumquam subteres, griseo-sericeus vel nonnumquam villossus et striis brunneis ornatus, tandem minus pilosus. *Folia* imparipinnata, laxa et vulgo pauca; basalia quidem multo breviora, foliolis 3-7, quorum infima decidua. *Stipulae* subulatae, ad 8 mm. longae, trinerviae, argenteo-hirsutae extus, persistentes. *Foliorum rachis* ad 15.5 cm. longa, abaxialiter sulcata, obscure pulvinata ad basin; *petioli* 2-5 cm. longi, saepe ad basin aeque crassi ac pedunculi, gradatim sursum fastigati. *Foliola* (3-7-) 9-17 (-19), opposita vel nonnulla alterna, (1-) 2-6 cm. longa, 0.5-1.2 cm. lata, terminalia quidem vulgo paulo longiora caeteris, atque rachis apici fixa; lateralia vero aequalia inter se, vel gradatim decrescentia sursum, elliptico-oblonga, paulum angustata ad basin vel saepius ad utrumque apicem, sericea infra, glabra supra, apice obtuso vel truncate emarginato, mucronulato; nervus medius eminens infra, laterales vero obliqui, secundum marginem decurrentes; *petioluli* ± 2 mm. longi, argenteo-hirsuti. *Racemi* terminales vel oppositifolii, valde elongati, 10.30 cm. longi, pedunculati, laxe 5-12-flori vulgo supra medium vel paulo altius floribus 1-3 ad singulos nodos, rarius ad nodum infimum suffultis uno folio parvo; *bracteae* longiores pedicellis, deciduae, ternatae, quarum inferior quidem paenitus stipulis similis, interiores vero laterales angustiores sed fere exteriorem aequantes. *Flores* cremei, 1.5-1.7 cm. longi pedicello incluso; *pedicelli* 1.5-3 mm. longi, dense argenteo-canescentes, tandem crassi sub fructu. *Calyx* dense argenteo-hirsutus extus; tubo 3-4 mm. lato, 1.5-3 mm. longo; lobis subaequalibus, lanceolato-subulatis, acuminatis, tubo longioribus, infimo quidem omnium longissimo, ± 5 mm. longo, lateralibus vero ± 3.5 mm. longis, superioribus binis connatis et distincte brevioribus, ± 2 mm. longis. *Vexillum* late obovatum, ± 1.5 cm. longum, 1.2 cm. latum, punctatum, unguiculatum, ungue 2-3 mm. longa, apice retuso apiculo minuto ornato, extus adpresse sericeo-brunneum, pilis densis et longioribus ad medium, marginibus ciliolatis supra basin. *Alae* ± 1.4 cm. longae, usque ad 4 mm. latae, punctatae, auriculatae supra unguem. *Carina* ± 1.5 cm. longa, usque ad 5 mm. lata, punctata, glabra, apice retuso et intus inclinato, marginibus exterioribus fere rectis. *Vagina staminalis* 1.2 cm. longa, 3 mm. lata ad basin, supra basin

dilatata; filamenta 2.5-3.5 mm. longa; antherae 0.5 mm. longae, 0.2 mm. latae; *filamentum vexillare* liberum usque ad basin, paulum dilatatum supra basin. *Ovarium* sessile, dense argenteo-hirsutum. *Stylus* 2·5 mm. longus, incurvatus, barbatus secundum faciem complanatam interiorem, tenuiter pubescens in facie exteriore; *stigma* minutum, glabrum. *Legumen* pallide brunneum, 6.5-8.5 cm. longum, 6-7 mm. latum, compressum, seminibus 8-11, rectum vel paulum falcatum ad apicem, glaucum inter semina, fortiter rostratum, rostro acuto et calloso, 2-4 mm. longo, fere recto vel paulum curvato; suturae valde crassae ad efformandum marginem eminentem ± 1 mm. latum, valvulis post dehiscentiam spiraliter convolutis, spiris 3-4; legumen tenuiter argenteo-canescens secundum suturas et ad utramque faciem. *Semina* oblonga, glabra, brunneola, nigro-punctata, strophiolo albo, 4-4.8 mm. longa, 2.5-3 mm. lata aliquantum reniformia.

Typus, *Sharma* 551-A, lectus ad Happy Valley in Rajasthan a me die 22 augusti 1959; isotypi, *Sharma* 551 *B-C*, lecti eodem loco ac tempore. Typus et isotypi positi in Herbario National Botanic Gardens ad Lucknow.

Tephrosia collina sp. nov.

This species does not appear to be allied to any other Indian species of the genus *Tephrosia*. It is characterised by simple or little-branched habit with fewer leaves; terminal or leaf-opposed, laxly-flowered, elongate racemes; creamy corolla and chiefly by few, 8-11-seeded long pods, bordered by much thickened sutures.

Annual herb, erect 30-60 cm. high. *Stem* simple or branching a little quite above the base, rarely suffrutescent, terete and thinly pubescent towards base, angled or occasionally subterete, grey-sericeous or sometimes villous and brown-striped above, at length less hairy. *Leaves* imparipinnate, lax and usually few; basal much shorter with only 3-7 leaflets, the lowermost one or two soon falling. *Stipules* subulate, up to 8 mm. long, 3-nerved, argenteo-hirsute outside, persistent. *Leaf-rachis* up to 15.5 cm. long, abaxially furrowed, obscurely pulvinate at base; *petiole* 2-5 cm. long, often at base as thick as the peduncle, tapering gradually upwards. *Leaflets* (3-7-) 9-11 (-19). opposite or a few casually alternate, (1-) 2-6 cm. long, 0.5-1.2 cm. broad, terminal usually a little longer than laterals and jointed to rachis-apex extending 1-2 mm. beyond the upppermost pair; lateral leaflets apparently equal or gradually decreasing in size downwards, elliptic-oblong, slightly narrowed towards base or frequently at both ends, sericeous beneath, glabrous above, apex obtuse or somewhat truncately emarginate, mucronulate; midvein prominent beneath with lateral nerves oblique—the ends running along the margins to some distance; *petiolules* ± 2 mm. long, argenteo-hirsute. *Racemes* terminal or leaf-opposed, much elongate, 10-30 cm. long, pedunculate. laxly 5-12 flowered from usually above the middle or still higher up, flowers 1-3 at each node, very rarely at the lowermost node subtended by a small leaf; *bracts* longer than the pedicels, deciduous, ternate—the lower exactly similar to stipules, the two inner laterals (bracteoles) narrower but almost equalling the outer. *Flowers* creamy, 1.5-1.7 cm. long (including pedicel); *pedicels* 1.5-3 mm. long, densely argenteo-hirsute later thickened in fruits. *Calyx* densely argenteo-hirsute outside; tube 3-4 mm. wide, 1.5-3 mm. long; lobes subequal, lanceolate-subulate, acuminate, longer than the tube, the lower longest, ± 5 mm. long, laterals ± 3.5 mm. long, upper two connate and conspicuously shorter, ± 2 mm. long. *Vexillum* broadly obovate, ± 1.5 cm. long, 1.2 cm. broad, punctate, unguiculate, the claw 2-3 mm. long, apex slightly retuse with a minute apiculum, back adpressedly silky-brown with hairs dense and longer along the middle, margins ciliolate above the base. *Alae* ± 1.4 cm. long, 0.4 mm. wide at its broadest, punctate, eared above the claw. *Carina* ± 1.5 cm. long, 0.5 cm. wide at its broadest, punctate, glabrous; apex retuse and pointing inwards, the outer margins almost straight. *Staminal-sheath* 1.2 cm. long, 0.3 cm. broad at base when explanate, dilated above the base; filaments 2.5-3.5 mm. long; anthers 0.5 mm. long, 0.2 mm. wide; *vexillary-filament* free down to the base, thinly widened, dilated above base as in sheath. *Ovary* sessile, copiously argenteo-hirsute. *Style* ±2.5 mm. long, incurved, bearded along the inner flattened face, thinly pubescent on outer; *stigma* minute, glabrous. *Pods* light-brown, 6.5-8.5 cm. long, 0.6-0.7 cm. broad, compressed, 8-11-seeded, straight or slightly falcate towards apex, glaucous within between the seeds, strongly beaked, the beak pointed and callose, 2-4 mm. long, almost straight or slightly curved; sutures much thickened to form ± 1 mm. broad prominent border, valves on dehiscence twisting completely by 3-4 turns; on faces and along sutures thinly argenteo-canescent with forwardly adpressed short hairs in var. *collina*; in var. *lanuginocarpa* at faces villous and along the sutures conspicuously fringed with dull-brown, stiff and almost erect short hairs of nearly equal length. *Seeds* oblong, glabrous, brownish and flecked with black, strophiole white; in var. *collina* seeds 4-4.8 mm. long, 2.5-3 mm. broad, somewhat reniform, in var. *lanuginocarpa* 5-6 mm. long, 3-3.2 mm. broad, at one or both ends nearly truncate.

Flowering and Fruiting : August to October.

Habitat : India : Ajmer district (Rajasthan), on hills throughout the district, chiefly among montane grasses.

T. collina var. **collina**

(Figs. A-H)

Pods on faces and along the sutures thinly argenteo-canescent with forwardly adpressed short hairs. Seeds 4-4.8 mm. long, 2.5-3 mm. broad, somewhat reniform in outline.

Flora of Ajmer, Rajasthan, India : *Sharma* 551-A, Happy Valley (Taragarh Mt.), alt. 450-550 m., Fl. & Fr. 22-8-1959, open hills (*type*) ; *Sharma* 551 *B-C* (*isotypes*): *Sharma* 586-*A*, Ajayasar Gate, above Happy Valley, Fl. & Fr. 17-9-1958 : *Sharma* 990, Nagpahar Mt., under shade of forests, Fl. & Fr. 23-8-1959: *Sharma* 1805, Todgarh, on way to Bhim, Fl. & Fr. 1-9-1961.

Type is deposited in the Herbarium National Botanic Gardens, Lucknow.

T. collina var. **lanuginocarpa** var. nov.

(Fig. I)

Legumina villosa ad facies, ad suturas vero pilis obscurate brunneis, rigidis, fere erectis, brevibus aequalibus ornata; semina 5-6 mm. longa, 3-3.2 mm. lata, truncata ad unum vel ad utrumque apicem.

Typus, *Sharma 1130-A*, lectus a me ad Nagpahar Mt. die 4 octob. 1959; isotypi, *Sharma 1130 B-C*, lecti eodem die ac loco.

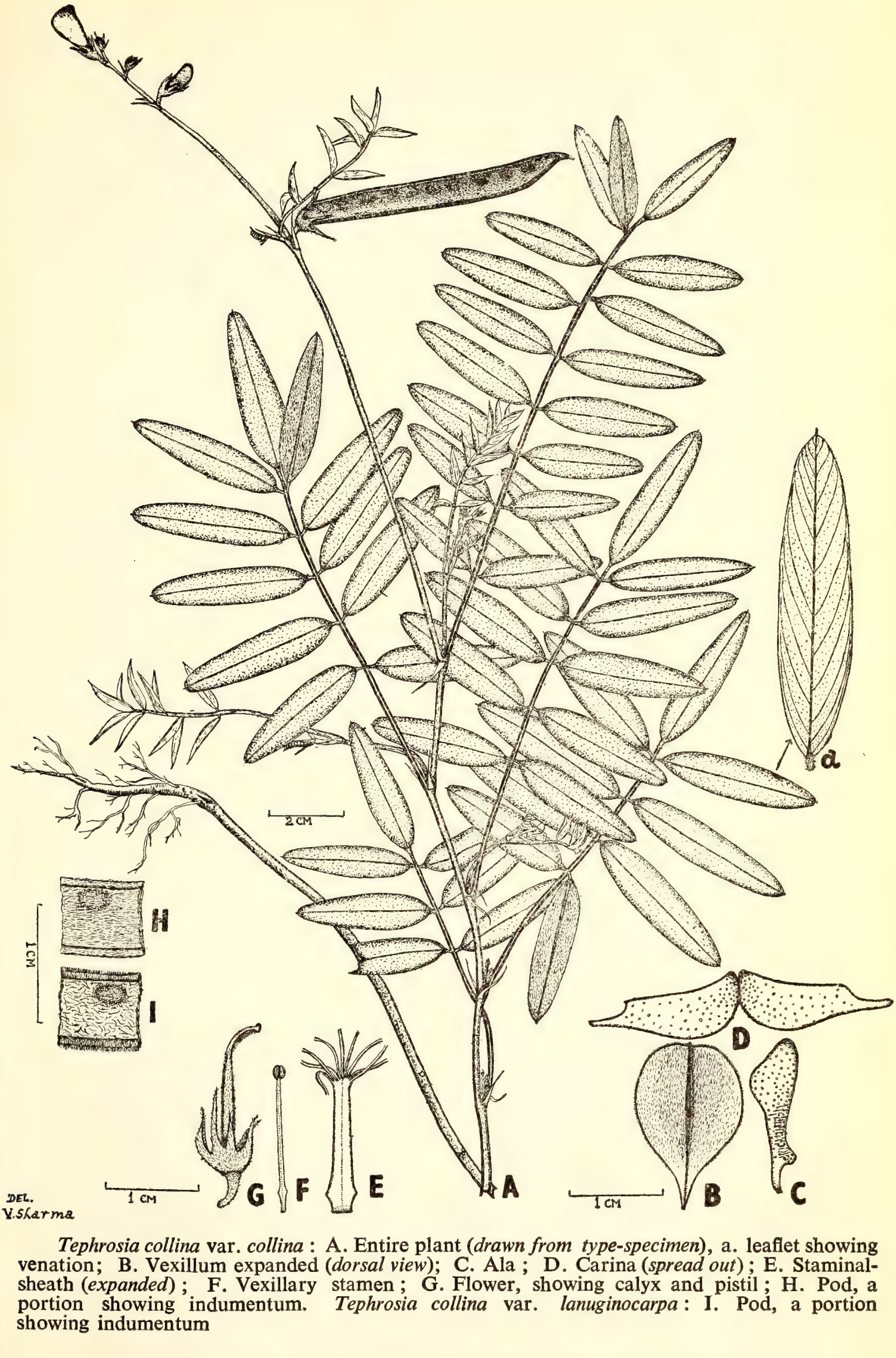
Typus et isotypi positi in Herbario National Botanic Gardens ad Lucknow.

Pods on faces villous and along the sutures conspicuously fringed with dull brown, stiff and almost erect short hairs of nearly equal length. Seeds 5-6 mm. long, 3-3.2 mm. broad, at one or both ends nearly truncate.

Flora of Ajmer, Rajasthan, India: *Sharma 1130-A*, Nagpahar Mt., alt. 370-550 m., Fr. 4-11-1959 (*type of variety*); *Sharma 1130 B-C* (*isotypes of variety*); *Sharma 586-B*, Ajayasar Gate, above Happy Valley, Fl. & Fr. 17-9-1958.

Type of variety is deposited in the Herbarium National Botanic Gardens, Lucknow.

As is evident from the above data, the present species is well distributed throughout Ajmer district which stretches to about 130 kilometres. The type as well as the var. *lanuginocarpa* may occur together within a small area confined to hills where they are chiefly seen among the montane grasses. It is fairly common at Todgarh and because of the identical topographical features of the adjoining area,



Tephrosia collina var. *collina* : A. Entire plant (*drawn from type-specimen*), a. leaflet showing venation; B. Vexillum expanded (*dorsal view*); C. Ala ; D. Carina (*spread out*) ; E. Staminal-sheath (*expanded*) ; F. Vexillary stamen ; G. Flower, showing calyx and pistil ; H. Pod, a portion showing indumentum. *Tephrosia collina* var. *lanuginocarpa* : I. Pod, a portion showing indumentum

there is every possibility that the species may extend beyond this region.

The above described variety appears to be a slightly more robust plant and is more hairy in all parts than the type form. It is mainly distinguishable by the kind of indumentum on the faces and sutures of the pods which persist even when the valves have separated. The character of the seed as keyed out above for the identification of the two forms, has been derived on the study of seeds from a few available mature pods. Unless more material is studied, the reliability of this character cannot be stressed.

It may be of some interest to record here that in one of the specimens the lowermost leaf showed reduction to the extent that it was represented only by a single leaflet, measuring 8×0.8 cm. with rachis (petiole) about 0.6 cm. in length.

ACKNOWLEDGEMENTS

I am grateful to Rev. Fr. H. Santapau for valuable suggestions and the Latin diagnoses. I am also thankful to my teacher Dr. B. Tiagi for encouragement, Dr. J. B. Gillett, Kew Herbarium, for the scrutiny of the material and helpful comments, Shri M. B. Raizada for the facilities of work at Forest Research Institute Herbarium, Dehra Dun, and the Curator, Central National Herbarium, Calcutta, for the loan of herbarium sheets of *Tephrosia*.

GOVERNMENT COLLEGE,
AJMER,
RAJASTHAN,
June 6, 1963.

V. S. SHARMA[1]

24. *SOLANUM ACULEATISSIMUM* JACQ. : A NEW RECORD FOR NORTHERN INDIA[2]

(*With a plate*)

While collecting some *Solanum* species from Jorhat and its neighbourhood (Assam), we came across this species which does not seem to have been recorded from northern India. C. B. Clarke, who wrote the Solanaceae in Hooker's FLORA OF BRITISH INDIA, cites only Thomson's specimen from Singapore for this species, with a note that his specimen in fruit is identical with the type specimen of *Solanum aculeatissimum* var. *denudatum* Dunal. J. S. Gamble in his FLORA OF MADRAS records this plant from Quilon in Travancore. But he does not give any description of the species beyond the statement that it is a prickly shrub.

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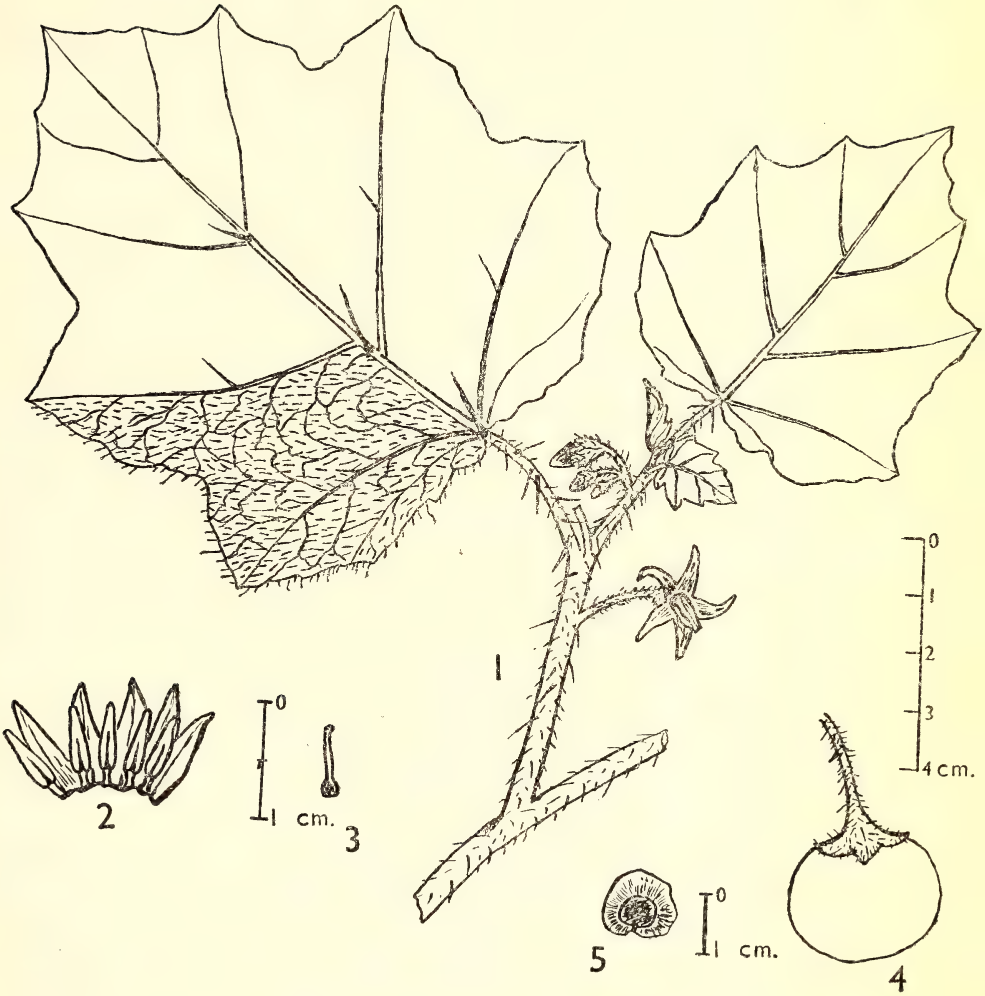
[1] Present address : National Botanic Gardens, Lucknow.

[2] Communicated by Rev. H. Santapau, Director, Botanical Survey of India, Calcutta.

Our correspondence with Dr. S. K. Mukerjee, Keeper, Central National Herbarium, brought to our notice the collection of this species by Rama Rao from Tharayamukka in 1912, from Trivandrum in 1913, and from Quilon in 1913. It is apparent that this species has not been recorded anywhere else in India.

Solanum aculeatissimum Jacq. Collect. Bot. 1 : 100, 1786.

Shrub about 1 m. tall; older branches brown, terete, glabrous; branchlets green, pubescent, spiny; spines tender, green, sharp, straight, varying in length from 0.2 to 1 cm.; hairs about 3 mm. long, rather sparse, stiff, erect. *Leaves* simple, alternate, distichous, exstipulate and petiolate; petioles green, tinged with purple in upper leaves in the grooves, 2-4 cm., terete, grooved above, pubescent, spiny; spines and hairs like those on the branchlets; lamina ovate, 8-10-lobed, entire at margins, acute at apex, somewhat cordate at base, hairs on the lower surface 2-3 mm. long, only on veins, hairs on the upper surface 1-2 mm., found all over, dense, spines only on the veins on both the surfaces, like those on the branchlets, sometimes tinged with purple when mature on the upper surface of the upper leaves; lateral nerves 3-4 on either side of the midrib, lowermost pair arising from the base of the midrib, extending laterally, nerves impressed on upper surface, prominent on lower. *Inflorescence* of helicoid cymes, generally in the axils of upper leaves, or extra-axillary, ebracteate, pedunculate; peduncles 5-7 mm. long, green, terete, very slightly tinged with purple, pubescent with stiff erect hairs which are almost like spines. *Flowers* regular, bisexual, ebracteate, pedicellate; pedicels like the peduncles. *Calyx* green, cup-shaped, persistent, 5×4 mm., slightly accrescent, pubescent with stiff erect hairs which are almost like spines, 5-toothed; teeth triangular, nearly 2 mm., entire at margins, acute at apex. *Corolla* 0.7×1.4 cm., rotate; tube about 2 mm. long, greenish, glabrous, hidden by the calyx; lobes 5, elliptic-lanceolate, about 7×2 mm., white, entire at margins, acute at apex, glabrous on both surfaces. *Stamens* 5, equal; filaments whitish green, less than 1 mm., arising from the base of the corolla, glabrous; anthers dorsifixed, yellow, lanceolate, about 5 mm. long. *Ovary* 2-celled with many ovules in each cell, arranged on an axile placenta, green, glabrous. *Stigma* green, otherwise undistinguishable from the style. *Fruit* a


1
2
0
1 cm.
3
0
1
2
3
4 cm.
5
0
1 cm.
4

Solanum aculeatissimum Jacq.

1. Twig ; 2. Dissected flower ; 3. Pistil ; 4. Fruit ; 5. Seed.

berry, spherical, 2.5 cm. or more in diameter, white with greenish streaks at the base when young, bright orange when ripe, glabrous and shining. *Seeds* numerous, winged, pale brown coloured, about 4 mm. in diameter, including the wings; wings circular, going all round the seed.

Flowering: More or less throughout the year.

Fruiting: More or less throughout the year.

Distribution: Tropical Asia and America.

Remarks: This species occurs wild in Assam on roadsides and in damp waste places, growing side by side in some places with *Solanum khasianum* Clke., which it closely resembles.

Chemical investigations on the species is in progress.

ACKNOWLEDGEMENTS

Our grateful thanks are due to Rev. Fr. H. Santapau, Director, Botanical Survey of India, for confirming our identification and also for guidance.

H. P. BEZBARUAH
BALAMANI BEZBARUAH

REGIONAL RESEARCH LABORATORY,
JORHAT,
ASSAM,
October 8, 1963.

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25. *HYPHAENE INDICA* BECC. ALONG THE WEST COAST OF INDIA

(*With a plate*)

Burkill (1908), in *J. Bombay nat. Hist. Soc.* **18** : 929, recorded a few interesting points of the Indian Doum Palm, *Hyphaene indica* Becc. besides other African species of the genus on the basis of Beccari's work. During the study of the flora of western India, the present writer collected and studied this species in further detail and found that the species is quite distinct from *H. thebaica* (Linn.) Mart., the Egyptian Doum Palm, which is only cultivated in a few gardens of India particularly of the west coast and the Indian Botanic Garden, Calcutta. *H. indica,* however, is the only species indigenous to the west coast of India.

H. indica grows along the sandy coast of western India almost adjoining the sea ranging from 18° to 23° N. lat. The areas newly recorded now, from which actual notes or collections have been made after study by the author, are coastal areas opposite Nagaon (on way to Revdanda from Alibag), Dahanu (only one broken tree and a seedling), Daman Grande (Jampore village, opposite market) (Plate, fig. 1), and small Daman. On the available information it can be noted that this palm grows at Shirgaon (beyond Palghar) and Okamandal, Diu (Saurashtra coast). It is also very likely that this species may occur along suitable sandy coastal belt further south of Alibag area and also along Daman-Diu range of the Gujarat State.

It is normally considered that all plants of *Hyphaene* growing in Indian gardens are *H. thebaica.* At Bombay, it is found that there is only one clump of well-grown plants of *H. thebaica* in Mazagaon hill garden (with pumping station), Bombay-10, and the small immature plant (about 7-8 metres) in the Victoria Gardens, Bombay, as kindly shown by Shri Irani in charge of the Botany section of the Gardens, may be either *H. thebaica* or *H. indica,* and the correct identity will be decided when the fruits of this plant are available. It is normally considered that the branched palms in the public garden of Baroda belong to *H. thebaica,* but the material sent from Baroda by Prof. A. R. Chavan of M. S. University, Baroda, is found to be *H. indica.* The author's recent scrutiny of the various palms of *Hyphaene* growing in the Indian Botanic Garden, Calcutta, reveals that there are three young fruiting palms of *H. indica* growing on a mound near the old, tall palms of *H. thebaica.* There is, however, no entry of *H. indica* in the Garden records. It is, therefore, of considerable interest that the indigenous species of *H. indica* has also found a place in the gardens of Baroda and Calcutta, possibly introduced inadvertently from the seed material of the palms growing along the Gujarat Coast or other parts of the western coast of India. It is necessary to check up whether all the *Hyphaene* plants growing in the Baroda gardens belong to *H. indica* only, or *H. thebaica* was also introduced in an earlier period, as in the Calcutta Garden, when such distinction between the two species was not clearly known.

It is difficult to distinguish the two doum palms, the Indian and the Egyptian, from vegetative characters. The fruit and the axis of female inflorescence provide distinct features (Plate, fig. 2). In *H. indica* the fruit (B_1) has a characteristic ovate shape with a distinct stalk (b_1, 10-15 mm.) covered by fine hairs and with rough cracked

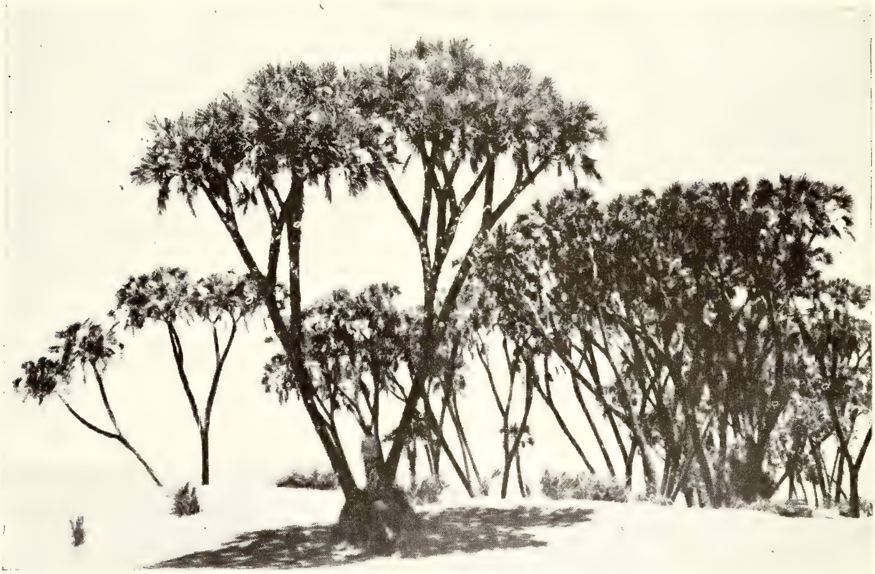

Fig. 1. Several trees of *Hyphaene indica* growing along the coast of Daman Grande, India

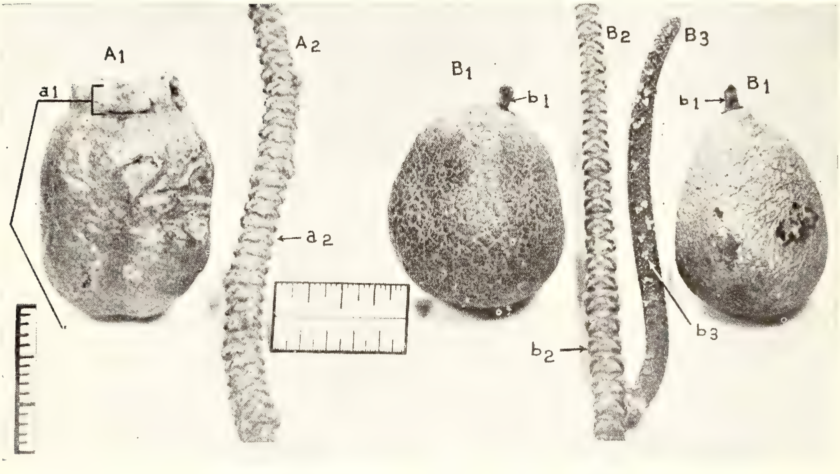

Fig. 2. Fruit and inflorescence of *Hyphaene thebaica* and *H. indica*

A. *H. thebaica*: A_1 fruit; A_2 female inflorescence axis; a_1 pedicel (much enlarged); a_2 tomentose cushion. B. *H. indica*: B_1 fruit; B_2 female flowering axis; B_3 male ditto; b_1 pedicel; b_2 tomentose cushion; b_3 male flowers.

(*Photos: Seshagiri Rao Rolla*)

exocarp, and the axis of female inflorescence (B_2) is less hairy with a few rhomboid tomentose cushion-like structures (b_2) in each spiral not quite prominent. In *H. thebaica*, the fruit (A_1) has an irregular oblong shape with an indistinct stalk surrounded by a thick bushy hairy cushion thus making it broader than high (a_1) and a smooth and glossy exocarp; the axis (A_2) is more hairy with larger number of rhomboid tomentose cushions (a_2) in each spiral distinctly protruding out. The internal structure of the fruit of both the species is mostly identical without any distinct variation.

It would be a good and interesting botanical acquisition if *H. indica* which is propagated by seed is introduced in the gardens and parks along the west and east coasts of India.

The author wishes to express his thanks to Prof. A. R. Chavan for kindly sending the material from Baroda.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE,
POONA, 1,
July 16, 1963.

SESHAGIRI RAO ROLLA

26. A NEW SPECIES OF *LASIURUS* FROM WESTERN RAJASTHAN[1]

(*With a plate*)

During a reconnaissance survey of the flora of Jodhpur district, the authors came across an interesting species of *Lasiurus*, a genus which is found commonly growing all over western Rajasthan. It was provisionally listed as *Lasiurus hirsutus* but examination in the herbarium showed that it is a distinct species.

At the outset, it should be stated that there are two recorded species of *Lasiurus* in north-west India, namely *Lasiurus hirsutus* (Forsk.) Boiss. and *L. sindicus* Henr., the latter being differentiated from the former solely on the basis of indumentum on the internode and peduncle.

The *Lasiurus* species collected by us did not agree with the description of the above two species although the inflorescence had some morphological similarities with that of *Lasiurus sindicus*. The specimen was sent to Kew Gardens, where Dr. Bor after studying the specimen, observed that the absence of tail to the lower glumes of the sessile and pedicelled spikelets is an important taxonomic character that distinguishes it from *Lasiurus sindicus.* In all the Indian sheets at Kew, the long tail is a very conspicuous feature in both species of *Lasiurus.* It was, therefore, considered that this plant merited specific rank by itself.

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[1] Communicated by the Director, Central Arid Zone Research Institute, Jodhpur, Rajasthan.

Lasiurus ecaudatus sp. nov.

It is distinguished by its large leaves, 3 to 4 racemes per culm, absence of tail to the lower involucral glume and absence of nerves on the lower floral glume.

Gramen perenne, fasciculatum plus minusve ramosum et lignosum infra, surculis intravaginalibus. *Culmi* pubescentes, 80-108 cm. alti, nodis 3.8-5 cm. inter se distantibus. *Vaginae* arctae, glabrae. *Ligula* contracta in fimbriam capillorum. *Foliorum* lamina linearis pulchre acuminata, ± 26.9 cm. longa, 4 cm. lata, glauca, glabra vel capillis nonnullis e tuberculo oriundis ornata prope ligulam.

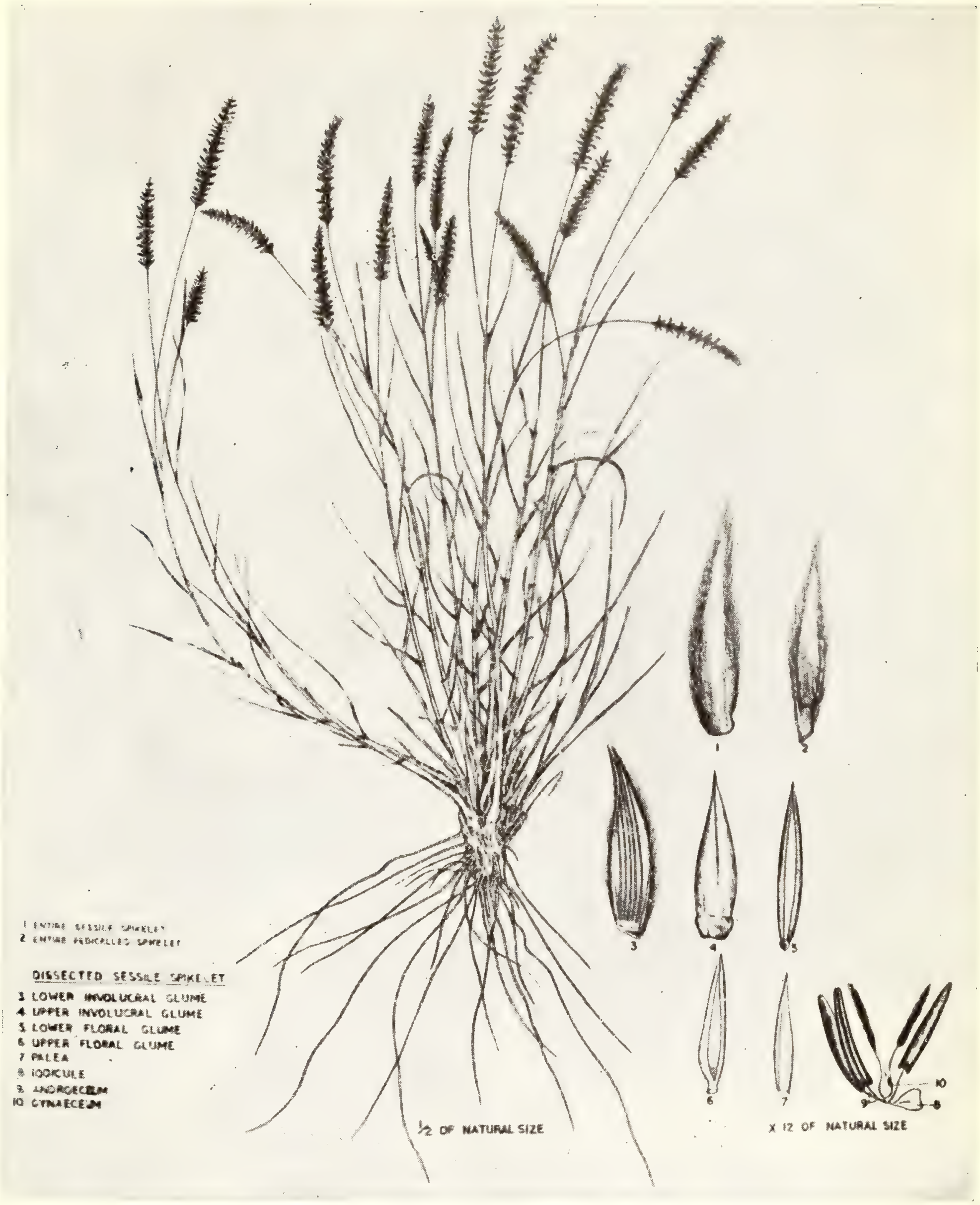
Racemi spicati 3-4 in singulis culmis, terminales et axillares; *pedunculi* dense pubescentes; *spicae* argenteae sericae, ad 11 cm. longae, 1 cm. latae, fragiles, articulis linearibus, 5-7 mm. longis, 2 mm. latis dorsaliter compressis, paene complanatis carina ornatis ad faciem interiorem.

Spicula sessilis lanceolata, 3·4.5 mm., rachis nodis barbatis; flosculi bini, quorum inferior masculus, superior vero hermaphroditus, arista nulla; gluma inferior 9 mm. longa, 59-nervia, ecaudata, ovata, fastigata supra, dense ciliata et membranacea; *superior gluma* carinata, 8-9 mm. longa, membranacea; *gluma floralis inferior* hyalina, 6 mm. longa, nervo nullo, ovata, acuta; *palea* hyalina, ovata, acuta, nervo nullo distincta, 3.9-4.9 mm. longa. *Lodiculae* 2, cuneatae; *stamina* 3, antherae 2.9 mm. longae. *Ovarium* 0.5 mm. longum; stylus 1.5 mm., stigmatibus linearibus exsertis 1.25 mm. longis.

Spiculae pedicellatae eis sessilibus similes callo indistincto glabro, utroque flore masculo vel reducto.

Holotypus: C.R. Farm, Central Arid Zone Research Inst., Jodhpur, Rajasthan, 250 m., 7 januarii 1962, *Y. Satyanarayan & K. A. Shankarnarayan* 719. In Herbario eiusdem instituti ad Jodhpur.

Perennial, tufted more or less branched and woody below with intravaginal shoots. Culm pubescent, height of culms varies from 80 to 108.8 cm. The distance between nodes 3.8-5 cm. Leaf sheaths closely clasping the culm, glabrous. Ligule a fringe of hairs. Leaf blade linear, finely acuminate, the average length being 26.9 cm., and


1 ENTIRE SESSILE SPIKELET
2 ENTIRE PEDICELLED SPIKELET
DISSECTED SESSILE SPIKELET
3 LOWER INVOLUCRAL GLUME
4 UPPER INVOLUCRAL GLUME
5 LOWER FLORAL GLUME
6 UPPER FLORAL GLUME
7 PALEA
8 LODICULE
9 ANDROECIUM
10 GYNAECEUM
1
2
3
4
5
6
7
8
9
10
½ OF NATURAL SIZE
X 12 OF NATURAL SIZE

Lasiurus ecaudatus sp. nov.

width 4 cm., glaucous, glabrous or with a few tubercle-based hairs towards the ligule.

Spike-like racemes 3 to 4 per culm, terminal and axillary. The peduncle is densely pubescent and the spike silvery silky all over. The spikes are up to 11 cm. long and 1 cm. wide, fragile, joints linear 5.0-7 mm. long, 2 mm. wide, dorsally compressed, almost flat with a keel on the inner surface.

Sessile spikelet lanceolate 3-4.5 mm.; nodes or rachis bearded all round. Florets two, lower male, upper hermaphrodite awnless; lower involucral glume 9 mm. long, 5-nerved with no cauda, ovate, tapering above, densely ciliate and membranous; upper involucral glume boat-shaped, 8-9 mm. long, membranous; lower floral glume hyaline, 6 mm. long, nerveless, ovate, acute, palea hyaline, ovate, acute, nerveless, 3.9-4.9 mm. long. Lodicules 2, cuneate; stamens 3, anthers 2.9 mm. long. Ovary 0.5 mm. long; style 1.5 mm. while stigmas are linear, exserted 1.25 mm. long.

The pedicelled spikelets are similar to the sessile ones with a glabrous indistinct callus and with both florets male or reduced.

Holotype. C. R. Farm, Central Arid Zone Research Institute, Jodhpur, Rajasthan, 250 mm., 7th January 1962, *Y. Satyanarayan and K. A. Shankarnarayan* 719, deposited in the Herbarium, Central Arid Zone Research Institute, Jodhpur.

Lasiurus ecaudatus sp. nov.	*Lasiurus sindicus* Henr.
1. Leaves 15-27 cm.	1. Leaves 7.5-15 cm.
2. Racemes at least 3 to 4 per culm	2. Racemes solitary
3. Lower involucral glume 9 mm. long	3. Lower involucral glume 10 mm. long
4. Tail or cauda absent in the lower involucral glume	4. Tail present in the lower involucral glume
5. Lower floral glume nerveless	5. Lower floral glume 3-5-nerved
6. Pedicellate spikelet similar in size to sessile spikelet	6. Pedicellate spikelet shorter than sessile spikelet
7. Pedicels 3 mm. long	7. Pedicels 4 mm. long

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Fr. H. Santapau S.J., Director, Botanical Survey of India, for the Latin diagnosis. We also thank Prof. P. V. Bole, St. Xavier's College, Bombay, for supplying literature on the genus.

CENTRAL ARID ZONE RESEARCH INSTITUTE,
GOVERNMENT OF INDIA, Y. SATYANARAYAN
JODHPUR, RAJASTHAN, K. A. SHANKARNARAYAN
August 26, 1963.

Gleaning

THE DESCRIPTION AND NAMING OF NEW SPECIES

In view of the gleaning at page 705 of the *Journal* for April 1962, Vol. **59** (2), our readers may be interested to read the following extract from a paper by B. H. Hodgson published in the *Journal of the Asiatic Society of Bengal*, Vol. **5** (1836), describing sundry animals enumerated in the Catalogue of Nepalese Mammals.

'The whole of the above animals were discovered by me several years back (1823-1829), and might have been described much sooner, had I not deemed it improper to hazard the multiplication of imaginary species by characterising from one or two specimens. There is not one of these species of which I have not procured several specimens at all seasons, and either alive or just killed. The indications of the catalogue are such as to entitle me to date from its publication (originally in 1829). But in truth, my object has been, and is, much less to share in the scramble of nomenclature, than to ascertain the habits and structure of species.

'Nothing is so vague at present as the true limits of species and as my *first* aim was rather to find resemblances than differences, so perhaps it might wisely have been my *last*.

'If, however, any person who chances to lay hold upon a single shrivelled skin, may forthwith announce a new animal, the real student of nature must be content to leave what is called discovery to the mere nomenclator; and the science must continue to groan under an increasing weight of fictitious species.'

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